# Skyways

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Flight
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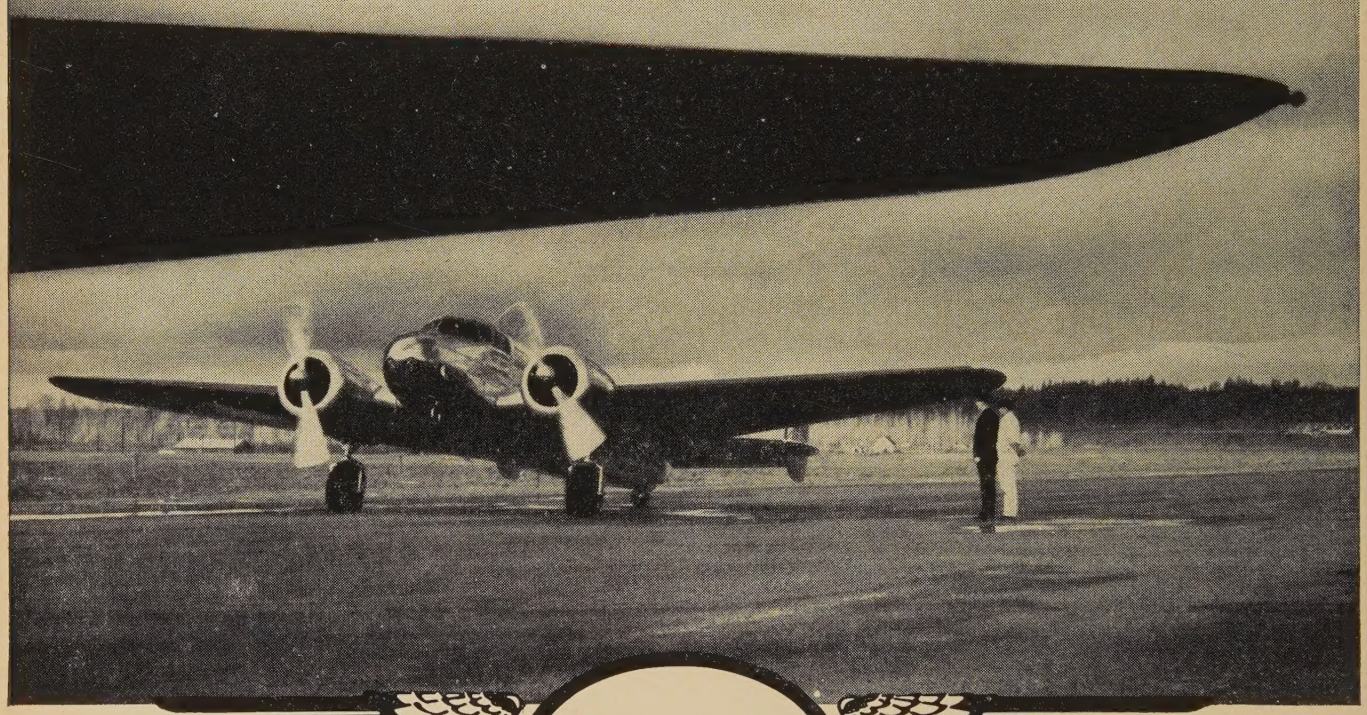
GUST 1954 50c

# Business is rising to the challenge...



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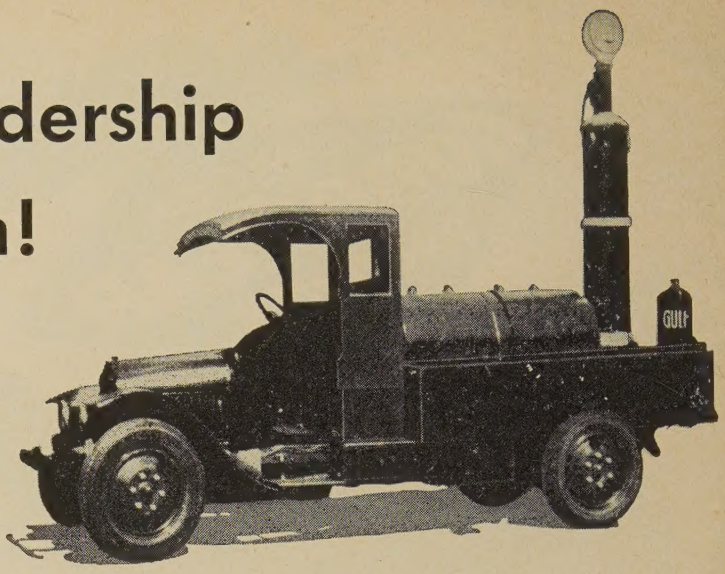
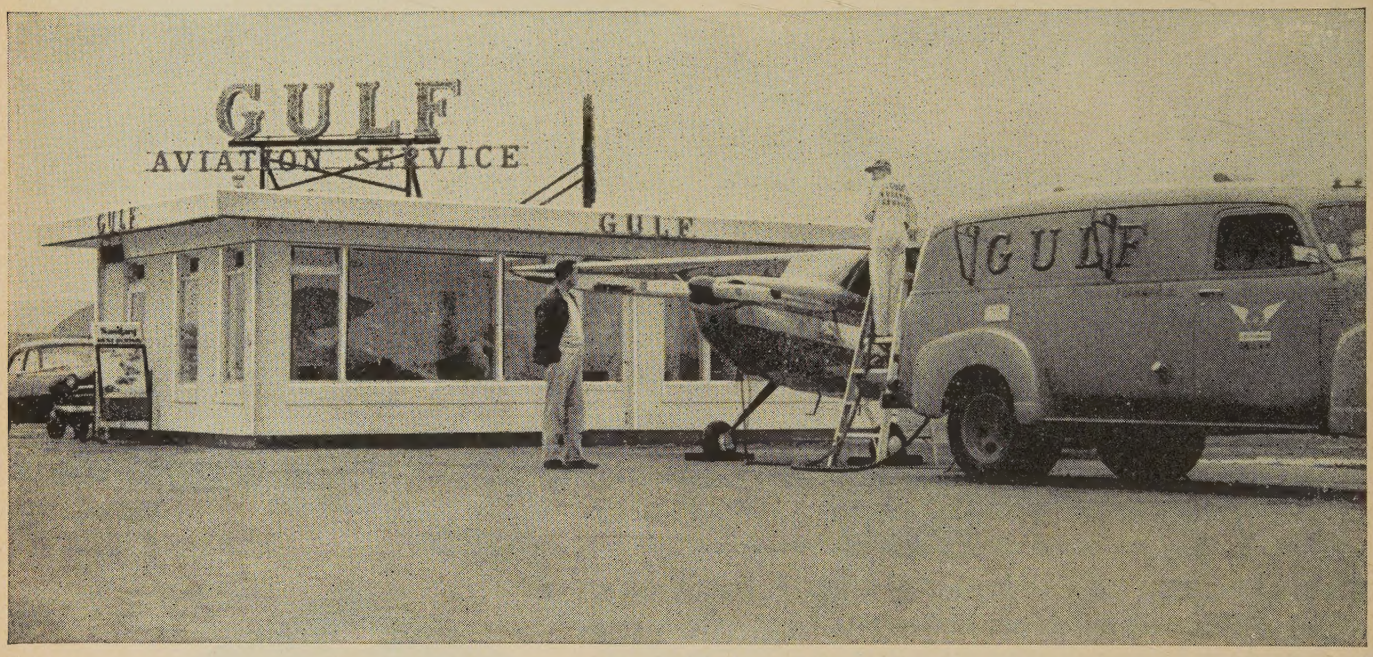



**This Gulf innovation of 1928,** believed to be the first mobile airport tender, proved a real boon to aviation. First used at Drew Field in Tampa, it speeded fueling by replacing the 5-gallon fuel containers previously used.




**Today,** users of Allegheny County Airport in Pennsylvania enjoy another Gulf innovation—the first airplane service station. Opened in 1953, it provides complete 24-hour refueling service for aircraft, as well as lounge, rest rooms, chart rooms and weather information.

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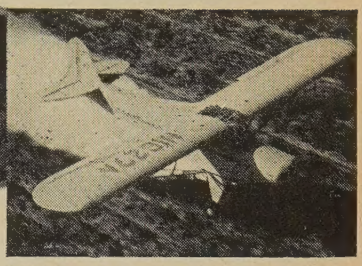
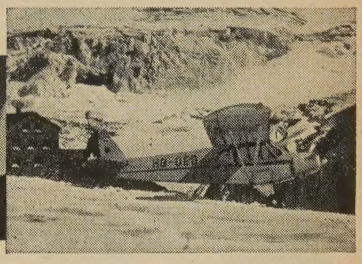
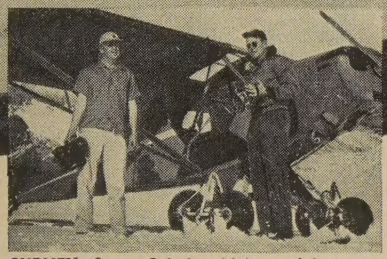


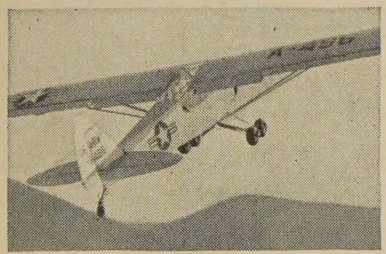
**DUSTER AND SPRAYER.** PA-18-A, agricultural version of the Super Cub, is world's most widely used plane for applying dust or spray.

**SKIPLANE.** Super Cub is ideal for snow flying, holds world record for high altitude take-offs. It's "the plane that doesn't need an airport."

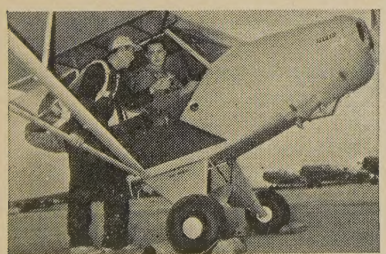




**SURVEY.** Super Cub is widely used in survey and line patrol since it can fly as slow as 40 mph, gives pilot and photographer good visibility.



**LIAISON.** Piper L-18 and L-21 observation-reconnaissance planes, with superb short-field ability, are used by U.S. Army and NATO nations.



**USAF TRAINING.** Cadets get first training in PA-18-T Super Cub. More people have learned to fly in Pipers than any other plane.

# "It takes a Super Cub to take it!"

Built for the really tough flying jobs, the Piper Super Cub is in use around the world on an astonishing variety of missions – expeditions high on mountain slopes, carrying missionaries deep into African jungles, patrolling pipe lines, training USAF cadets, dusting, spraying, hauling incredible loads in and out of short, rough strips.

While the Super Cub is famed for its performance it is noted also for its rugged, trouble-free design. Its stamina is best summed up by Ed Molitor, veteran San Diego pilot, in telling of the Super Cubs' use with the long-range tuna boats. Operating in the open Pacific these Super Cubs on floats save enough time scouting for bait to permit the tuna clippers to make an extra trip every year.

"The boats remain at sea from two to four months and the planes must be ready to fly at all times," says Mr. Molitor. "When you land a seaplane in the open sea under adverse conditions, it takes a Super Cub to take it."

If you have a tough flying job to do or if you want an airplane whose sheer performance will give you a new conception of aircraft utility for farm, ranch or private flying, see, fly and buy the Super Cub – unmatched anywhere in the world.

*NEW SUPER CUB BROCHURE. Send today for new brochure on the Piper Super Cub and PA-18-A agricultural plane. Dept. 8-K*

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## How's your lawnmower working

Not getting the lawnmower fixed until the grass is knee-high is a fairly common experience to many people—and not worrying about aircraft heating in August is a similar situation. But, if you intend to fly cozy and warm next winter, *now* is the time to install that new Janitrol heater you've been planning on, or at least to make a thorough overhaul check of your present installation. Your favorite aircraft modification organization—where you keep your plane(s) can help you get the most out of your present equipment, or install a new Janitrol system.

Here, for very good example, is a pleasant young flyer appraising one of the classics of aircraft heating history. It's a Janitrol S-200 heater, one of the most popular sizes for commercial, corporate, or private aircraft use. Output is 200,000 Btu/hr, weight just a shade over 28 pounds, length about 20", diameter about 10"—a very compact piece of equipment! Other units in the complete Janitrol line range up from 25,000 Btu/hr. in output. There is a size, to cover every heating need even though you plan to base at the North Pole all winter!

Soooo—as I said, better move *now* to solve the problem of comfort and utility heat (with a Janitrol of course) for all those winter flights ahead of you. And one last brag about our standing in the industry—over 100 different types and designations of aircraft from grasshoppers to flying battleships are Janitrol equipped—proof that for aircraft heating dependability, you can't beat Janitrol!

Cordially,

Joe

Janitrol Aircraft-Automotive Division,
Surface Combustion Corporation,
Columbus 16, Ohio

AUGUST, 1954

# Skyways

**Flight Operations • Engineering • Management**

*Cover: Douglas twin-jet bomber, RB-66A*

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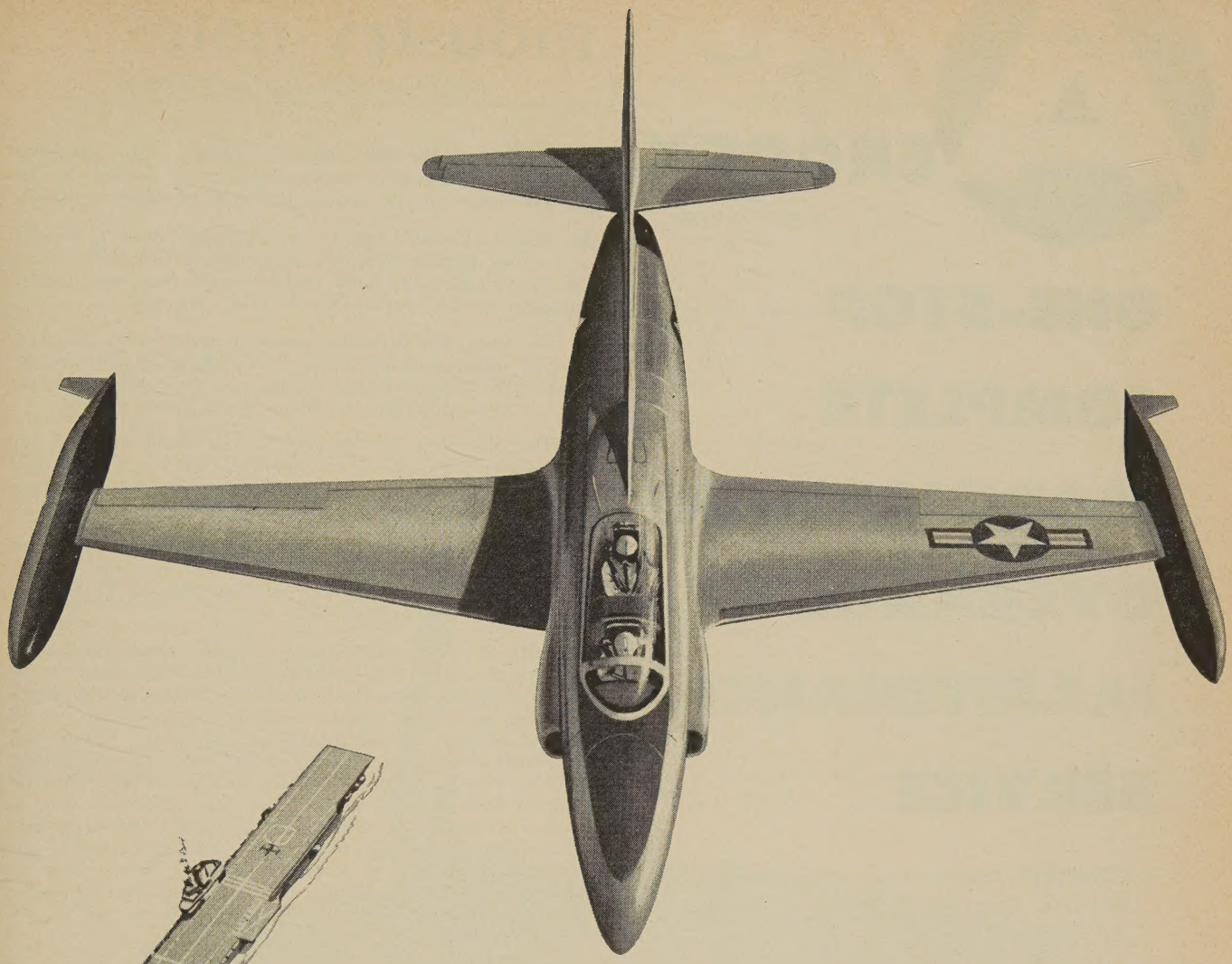

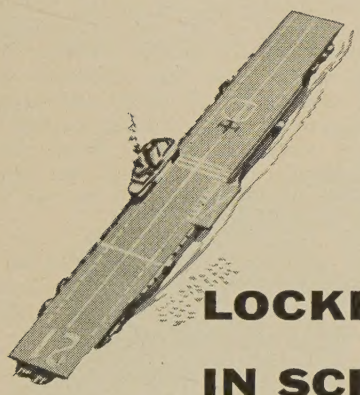

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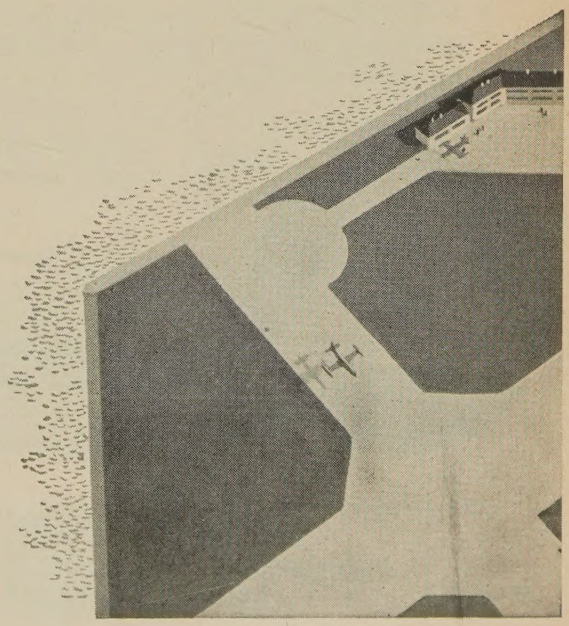
It gives maximum training potential, even down into lower phases of training now requiring propeller-driven planes.

Lockheed has engineered into this trainer aircraft a wide variety of new safety features, including stall slats and an elevated tail with greatly increased surfaces. It is beyond a doubt *the safest jet airplane ever built!*

For easier training of even better jet pilots, this airplane has:—an unrestricted canopy . . . a wrap-around single windshield . . . rearranged and redesigned seats, including a telescoped ejection seat . . . and a greatly simplified cockpit and instrument panel—all providing the optimum arrangement for tandem training.



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# industry notes . . .

■ The Air Force has signed a contract with Continental Aviation & Engineering covering production tooling for the J69 gas turbine and the manufacture of five production engines.

■ Douglas Aircraft's twin-jet reconnaissance bomber, RB-66A, (*see cover*), recently completed its first flight. George R. Jansen, Douglas test pilot was at the controls of the swept-wing bomber developed for the Air Force Tactical Air Command.

■ The Navy's F7U-3 *Cutlass* is now equipped with a new type fuselage rocket pack containing 2.75″ Mighty Mouse air-to-air rockets. The Chance Vought *Cutlass* also can carry two rocket pods on its wing pylons, in addition to its 20-mm cannon.

■ The U.S. Navy has reported the successful flight of two rocket-powered helicopters, the Rotorcraft RH-1 and the Kellett KH-15. Both are powered by small rocket units built by Reaction Motors, Inc., and installed at the rotor tips.

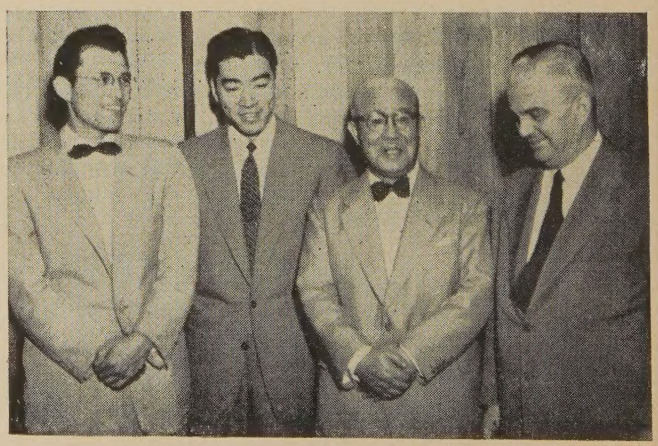
■ Ryan Aeronautical has stepped up production of the jet-powered *Firebee* target drone for the USAF, the Army and the Navy, and is moving ahead with its delta-wing, jet VTO fighter powered by a Westinghouse J40.

■ North American Aviation has confirmed a report that an engineering group has been established within the company to restudy designs for a medium twin-engine business aircraft which will meet the high-performance specifications outlined by the National Business Aircraft Association. The aircraft in this category would cruise at a minimum of 300 mph, have accommodations for 8 to 10, be pressurized and provide minimum effective range of 1,000 miles at normal gross. The exploratory work at North American also is covering aircraft smaller and larger than the 8-to-10 type. The engineering group is being assisted by the company's financial and marketing experts. North American launched a similar project more than a year ago, but suspended it after preliminary studies of the market and the cost of producing a prototype.

■ General Electric has developed a remote-controlled tail turret system especially adapted for high-speed jet plane operation. Now being installed on the Boeing B-47E *Stratojet* bomber, the turret can track and shoot down unseen targets.

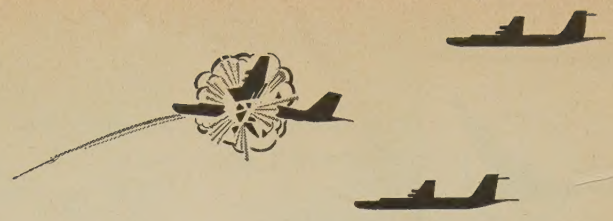
■ Summers Gyroscope Company's PAR Pilot, a 17-lb, two-axis auto-pilot, has been certificated by the CAA. Components of the control system are Summers PAR Gyro, Flight Controller and two Model 205 Position Servo Actuators.

■ Officials of Fuji Motors Corp., Tokyo, and Continental Motors Corp., have a license agreement under which Fuji Motors will manufacture Continental E185 aircraft engines in Japan. Those participating in the signing of the agreement were (*below, left to right*) G. Maruyama, Richard S. Iwata, Souji Yamamoto, and C. J. Reese, president of Continental Motors.

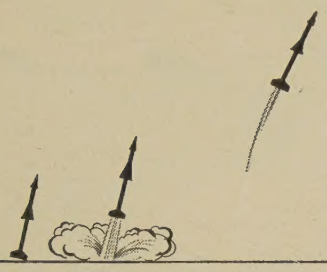


*Regardless of evasive action*

*this radar-guided missile*



*intercepts bombers at supersonic speed*

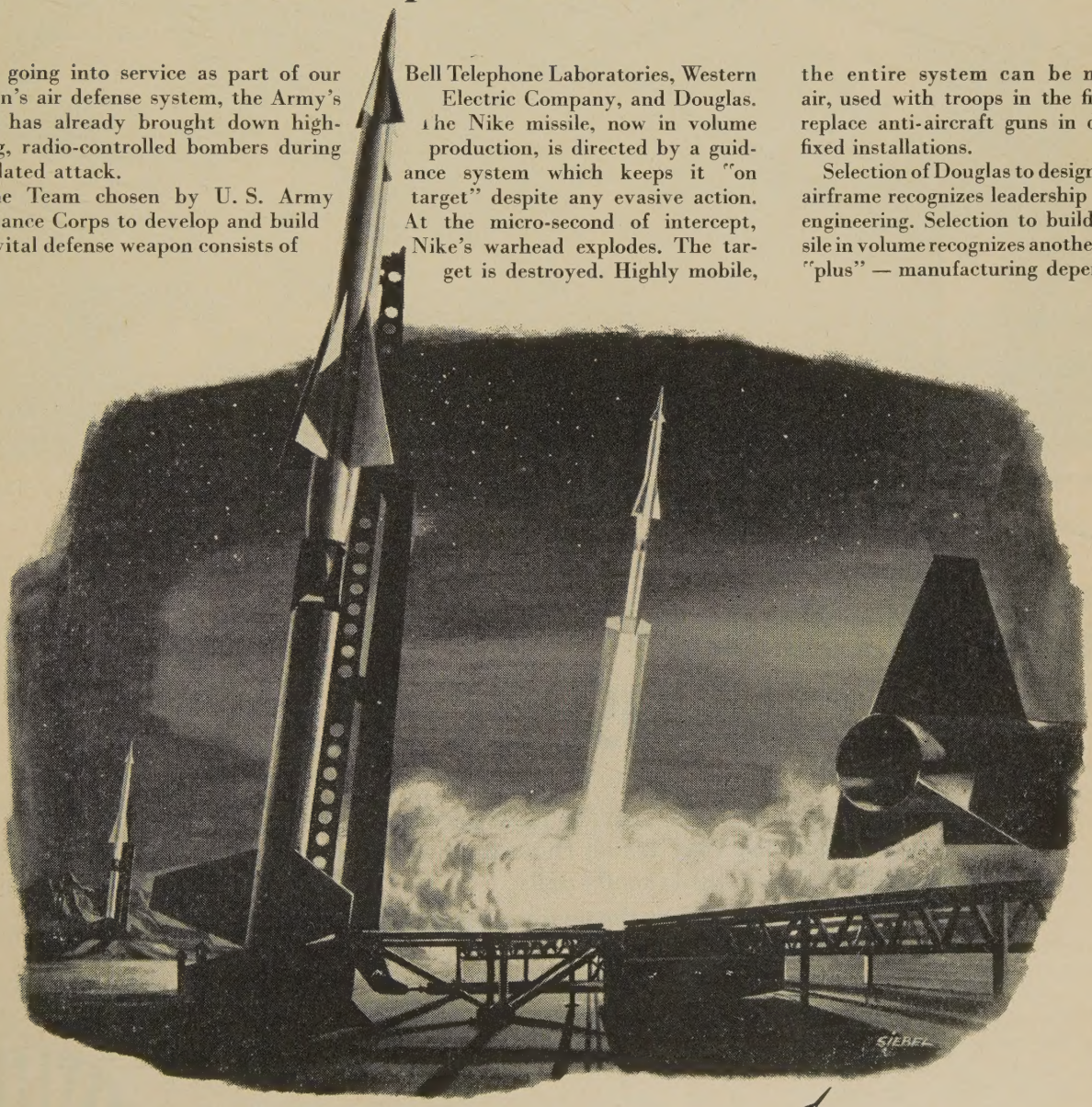


## Nike—product of teamwork

Now going into service as part of our nation's air defense system, the Army's *Nike* has already brought down high-flying, radio-controlled bombers during simulated attack.

The Team chosen by U. S. Army Ordnance Corps to develop and build this vital defense weapon consists of Bell Telephone Laboratories, Western Electric Company, and Douglas. The Nike missile, now in volume production, is directed by a guidance system which keeps it "on target" despite any evasive action. At the micro-second of intercept, Nike's warhead explodes. The target is destroyed. Highly mobile, the entire system can be moved by air, used with troops in the field, or to replace anti-aircraft guns in defense of fixed installations.

Selection of Douglas to design the Nike airframe recognizes leadership in missile engineering. Selection to build the missile in volume recognizes another Douglas "plus" — manufacturing dependability.

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**AIRLINERS** *are made up of an imposing number of detail parts which must be given design attention to eliminate failure possibility*

# Airplane Design and SAFETY

by R. W. Rummel
*Chief Engineer*
*Trans World Airlines, Inc.*

The subject "Airplane Design and Safety," is as extensive as airplane design itself, as complicated as our newer transports, and as fundamental as mathematics. It applies to every aspect of design, major and minor alike, because almost every airplane component, including such small items as rivets and wire terminals or such major items as landing gear or wing spars, can be and sometimes have been involved directly in matters of safety. Aircraft are made up of an imposing number of detail parts which must be given proper and adequate design attention in order not to cause difficulty. Fortunately, the present state of the art is such that a very small percentage of the total number of parts or components actually ever cause any trouble.

The remarkably good scheduled-airline safety record that has been attained can be viewed as a tribute to the designers, to the operators who must exert constant vigilance and to the federal authorities who establish minimum acceptable criteria and review and approve the aircraft for use in interstate commerce.

Safety is an ever-present consideration of responsible people involved in the manufacturing, operating and legislative phases of the air-transportation business. Safety is seldom absolute in any form of locomotion and in ordinary use is a relative term of reference. This single, all-embracing aspect of airplane design can cause more heated controversies, finger pointing or "witch doctoring" than any other single aspect of design. And it is correct that it should for it is of vital concern to all of us and the welfare of the industry is associated with its attainment.

Volumes can be written and rewritten on the detailed aspects of safety with relation to airplane design. In this instance, however, I

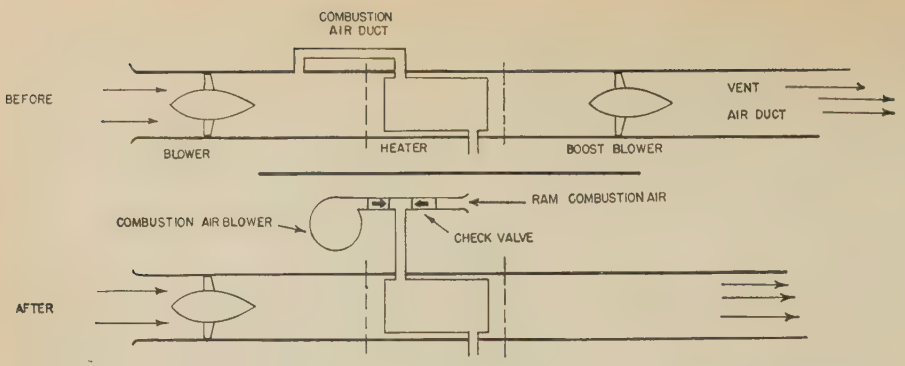



**FIG. 1**— *Schematic shows design deficiency (top) in airliner's heating system, and the developed solution (bottom) to the problem of inadequate airflow in system*

should like to discuss an operator's views on some principles of design and the desirability for improvement.

The first principle for increased safety is this: *Design aircraft so there exists the* least *likelihood for transmitting inaccurate or misleading information to the flight crew.* Incorrect information can create unnecessary conditions by causing the pilot to take what in an emergency would be correct action but in reality would be inappropriate under the circumstances. Perhaps the most vicious item falling in this category is the false warning, especially the false fire warning.

Virtually every fire-warning system with which we have had experience has been subject in actual service to a certain number of false warnings. These have been too frequent and they indicate the need for improvement in reliability. Such systems should provide positive emergency indication, give no false warnings, and should be capable of easy manual but preferably automatic continuity checks. Some of the newer systems give promise of improvement in certain directions, but more needs to be done. Perhaps the necessity for the development of more reliable turbine engine-temperature indicators will pave the way for better detection systems.

To cite an example of how misleading incorrect information can be, a case was reported sometime ago wherein the warning light for a cabin-heater compartment came on in a modern four-engine pressurized aircraft cruising at about 18,000 feet. The pilot went through seemingly appropriate procedures, including discharging the fire-extinguishing agent, after which time the warning light went off. A few minutes later the same warning light came on and the pilot again discharged $CO_2$, whereupon the light again went out. A short time later the warning light came on a third time. At this point the pilot put the airplane into an emergency descent and made a successful landing at the nearest field under far from ideal conditions. Upon examination of the heater compartment, it was found that no fire had existed, but an intermittent short occasioned by fatigue was the cause of all of the warnings.

In another case a false warning led a pilot to land his four-engine, advanced-type transport in unfamiliar locale on a paved strip only 2500 feet long—and without reverse thrust. While the landing was made without damage to the aircraft or injury to the passengers, it was not under the best of conditions and, except for the false warnings, would never have been attempted.

Many airlines have experienced such incidents. A number of false warnings could be avoided by closer attention to detail design, including more adequate support for and improved abrasion resistance of wires, better terminal design by making installations less vulnerable to fatigue, less vulnerable to damage from necessary personnel handling, and such obvious things as thermocouple location and temperature range. To illustrate the latter item, a series of aborted take-offs on a certain type airplane were necessary because the warning unit was located so that with the cowl flaps in position for take-off on hot days the detection unit became too hot and responded with an indication. This condition has been corrected, but it never should have existed in the first place. Another new type airplane reportedly had identical difficulty even though it was manufactured a full year later. It too has been corrected. In each of these cases such testing of the systems as was done by the designer obviously did not simulate actual conditions or consider the necessary operational tolerances.

While none of the cases of false warning referred to here resulted in accidents, an exposure to potential trouble was involved and, if repeated often enough, would be caught up with some day by the law of probability.

Other types of misinformation that can lead to trouble are false landing gear position indication, incorrect flap position information and incorrect fuel gauges, not to mention incorrect flag position on flight indicators, incorrect instrumentation, incorrect navigation information, etc.

It is hardly necessary to mention that repeated false indications can be vicious since repetition is disarming and tends to breed neglect and/or lack of confidence in the warning system involved. This applies to both false *danger* as well as false *safety* warnings.

The second principle of design is *always to provide simple means*

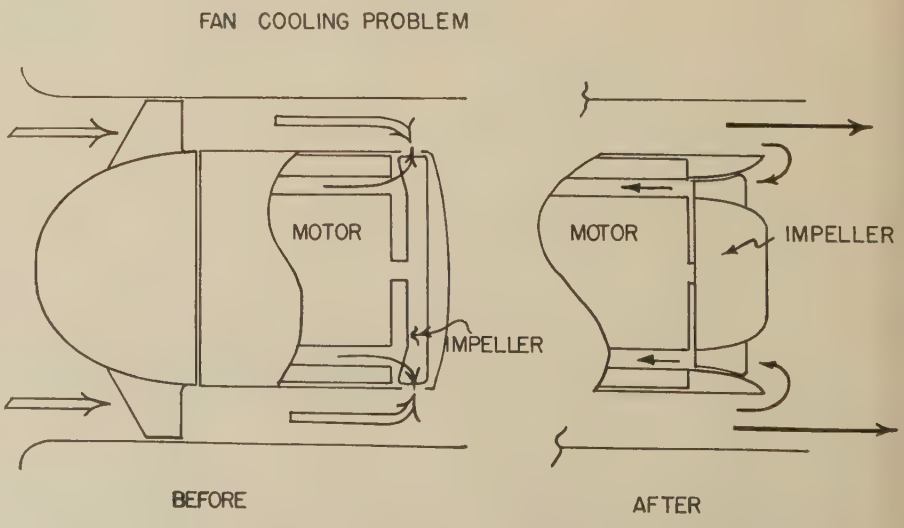



**FIG. 2**— *When a blower failed after few hours of operation, it was discovered that by reversing the cooling fan the proper airflow was established to keep fan from overheating*

*whereby the pilot can expeditiously, intelligently and reliably cope with such emergency situations as may arise.* To illustrate this, one recent aircraft had a single switch which deactivated all of the non-essential electrical loads and other loads not required to maintain straight-and-level flight, retaining minimum navigation and communications equipment. Thus, when the pilot receives a warning indication or suspects electrical system difficulty, he must do one thing and one thing only—throw an emergency switch which deactivates a bus powering approximately 90% of the electrical system. The chances are then about 10 to one that he also has deactivated the source of trouble. Then he can hunt for the trouble by activating suspected circuits one at a time on a less urgent basis. The same type of thinking and planning can and should be applied to other aircraft systems in future aircraft.

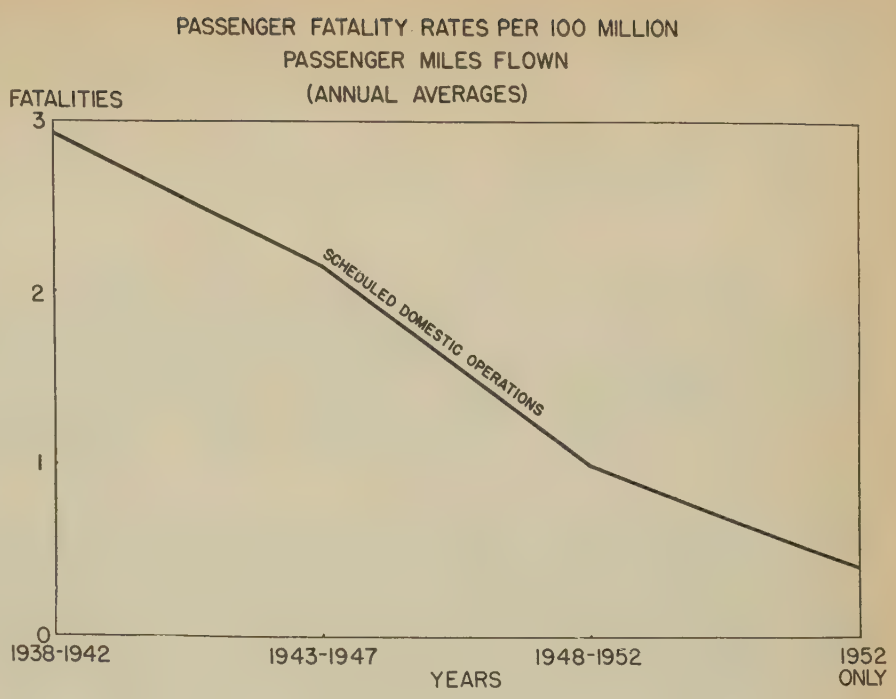
We have long believed that emergency systems, such as fire extinguishing, flare release, firewall fluid shut-off valves, and the like, should be manually actuated rather than have their usefulness dependent upon the integrity of a power system. This, quite obviously, is because the system which caused the emergency to arise in the first place may be the same system which powers the emergency device, thus making advisable protective action impossible. However, as aircraft become larger the practicability of manual systems diminishes, which is by way of saying that because of the size problem all the more justification exists for the application of design ingenuity to match the reliability of the simple direct manual system. To further emphasize this general point, it should be kept in mind that major accidents are seldom caused by the occurrence of only one unusual circumstance but are almost always the result of a combination of several unusual circumstances, all usually compounding against safety at a critical time.

Quite obviously, the simpler the aircraft can be made, the greater command the pilot will have of such emergency situations as may arise. An aircraft of really simple design should present a relatively simple emergency evaluation problem for the crew, and in addition should have the advantage of being an airplane that is relatively easy to operate and the least subject to mechanical failure. However, an airplane designed specifically to simplify cockpit procedures for normal operation, itself an important safety attribute, is not necessarily an airplane that can be readily diagnosed under emergency conditions. For example, one way to simplify cockpit procedures is to make systems more and more automatic so that the flight crew is able to devote more time to matters other than detail. Pressurization, air flow and temperature controls in some late-type aircraft are examples. Autoelectric load monitoring, automatic fuel-tank selectors, and inertia switches are a few examples of devices aimed at relieving the flight crew of detailed duties which can detract from the main job at hand. The addition of automatic systems and gadgets adds considerable complexity to the airplane. And while it improves safety by relieving crew work load, it also can complicate the crew's problem of coping with emergency situations, because this very added complexity of design adds to the difficulty of making rapid analysis of the cause of trouble as well as determination of the proper corrective action. Also, the greater the number of accessories, the more extensive and complicated the systems, the greater is the opportunity for failures and attending hazards. This being the case, a plan for gross deactivation or system immunization, such as mentioned before in the specific case of one type aircraft's electrical system, should be sought to be included in all future aircraft to simplify diagnosis of trouble.

The third principle—*simplicity of design*—has already been touched on, but I would like to emphasize it further. Much has been said about the complexity factor, its serious effect on manufacturing costs, its general adverse effect on maintenance, its contribution to delays, and its proneness to promote difficulties of trouble-shooting. All of these negative factors are unquestionably true, and alone are sufficient cause to emphasize and re-emphasize simplicity. It has been my observation that it is generally much easier to design a complicated gadget or system than it is to develop a simple unit. Ordinarily, the simple functional design is the result of either sheer genius or of tedious and time-consuming efforts which are frequently an evolutionary process from the complicated design to the simple one. Aircraft seem to stand in a complexity class all by themselves inasmuch as they include more safety devices, protective circuits and emergency systems per cubic foot than any other public transit machine. The addition of all these safety devices does provide elements of safety, but there is such a thing as compounding safety protection to the point where the overall complex design may be less safe than would be a simple, direct, unprotected but ruggedized system. There is no substitute for sound judgment based on experience in this matter, but certainly much should be said in favor of greater simplicity.

Generally speaking, it would seem

(*Continued on page 41*)




**SAFETY RECORD** *of U. S. scheduled airlines is a tribute to the aircraft designers, the operators and the federal authorities who review and approve aircraft for commercial use*

# REDUCING COSTS and INCREASING UTILITY

**AIRCRAFT SERVICE** *Bonanza, shown here being towed to ramp at Cleveland Hopkins Airport, is used for companies' short-haul flights*

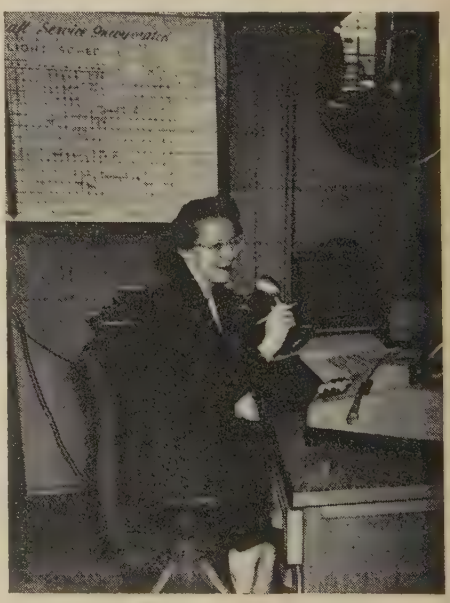
At some point in almost every business aircraft fleet operation, the problem of tightening up costs without sacrificing utility and flexibility rears its ugly head. As with any other business machine, the advantages of company airplanes have to be weighed against their costs.

The F. C. Russell Company of Cleveland, one of the nation's largest producers of combination windows and doors, faced that problem in 1951 and found a remarkably effective solution. It is so effective, in fact, that the company has found it possible to increase its fleet of aircraft and to use them profitably. Few companies can make that statement.

The company followed a familiar pattern in its approach to and use of aircraft immediately after the war. With the business entering a period of rapid expansion, F. C. Russell, president, decided in 1946 to apply the advantages of the airplane's speed to his travel problems. The first airplane was a Cessna T-50, a twin-engine military trainer converted to a five-passenger transport.

Typically, a few months later, Russell began to demand more speed and in January, 1947, the company bought a Beech C-18S. Russell reasoned that if the faster airplane enabled him and his associates to attend only one additional sales meeting during the year it would be worth its cost. The Beech replaced the T-50 and the company continued for a few months as a one-airplane operator.

However, it soon became apparent to top executives using the C-18 that all traveling personnel in the company could and should share the benefits of time saving and flexibility possible with a company airplane. Simultaneously, word was received that Beech was well along the way



**SECRETARY** *in flight office summons a pilot on hangar public address system*

by Franklin D. Walker

*How one company cut aircraft overhead costs without sacrificing the utility and flexibility of its business aircraft fleet operations*

toward production of a new executive airplane. The Russell Company placed its order and, early in 1948, took possession of one of the first *Bonanzas*—a four-placer ideally suited for short, economical trips. By 1951, the Russell fleet had grown to two Beechcrafts and two *Bonanzas*.

And by 1951, Russell and his chief pilot, Clint Bacastow, had begun to take a searching look at the company's aircraft and their increasing overhead. Experience had proved that 60% of the cost of operating the airplanes was fixed overhead and 40% was direct operating cost. Costs had to be justified by weighing the airplanes' advantages and comparing costs with other types of transportation. The company had consistently tried to reduce its aircraft costs without sacrificing utility, but the problem was never solved satisfactorily. It remained one of how to spread fixed overhead over as many hours, or miles of transportation, as possible and still retain the flexibility of fleet operations.

An analysis of the aircraft and the types of trips they logged indicated a potential of 800 hours a year for a *Bonanza* and 1,000 hours for a twin-engine airplane—without significant increase in overhead.

"A concentrated effort of coordinating schedules and travel times helped to achieve this utilization," Bacastow explained recently, "but it was apparent that there was not sufficient executive travel to accomplish our goal."

Over-emphasis on coordinating trips, he said, tended to destroy the flexibility of travel schedules—a basic advantage in the use of company aircraft. It was obvious, of course, that some reduction in cost and increase in utilization could be achieved by reducing the number of aircraft, but that would have meant a significant loss in flexibility.

On the basis of a thorough study of its aircraft activities, including a look at the consequences of cutting the fleet back to perhaps one airplane, Russell and Bacastow worked out a neat solution. It solved the problem in economics, pushed Russell Company aircraft utilization to a new high and benefited other business aircraft users in Cleveland area.

The first step was the Russell Company's purchase of Aircraft Service, Inc., one of the oldest charter, repair and flight school operations at Cleveland Hopkins Airport. Aircraft Service transferred its assets and hangar lease right to the Russell Company and became its wholly owned subsidiary.

Established primarily for the Russell fleet, Aircraft Service immediately became a charter service for other companies and a maintenance center for Russell and other corporate-aircraft owners. With its own maintenance shop, the Russell Company could keep to a minimum aircraft time lost on the ground.

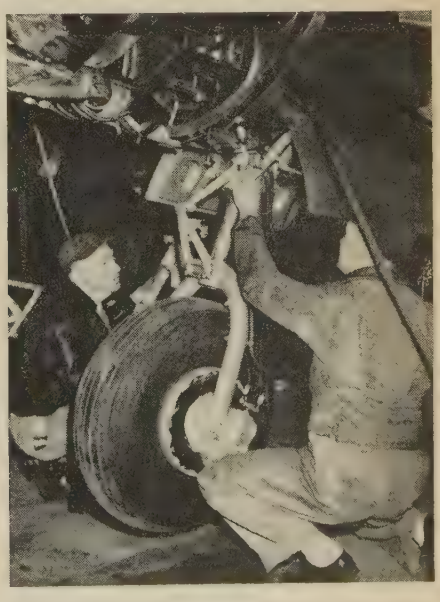
Experience has shown that, regardless of the number of aircraft a company owns, there are occasions when the fleet is inadequate and times when airplanes are idle. Idle airplanes are costly.

It is obvious, too, that no one airplane is ideal for all types of flights. The answer to this problem is a fleet of different airplanes—single-engine for short trips where economy is essential, a small twin for average trips with small groups, and a deluxe "flying office" for extended trips.

As a subsidiary of the Russell Company, Aircraft Service has been an outstanding success since it was reorganized two years ago. It has brought about reduced maintenance cost, increased utilization and lower operating cost and enabled Russell to buy a DC-3 for company and

(*Continued on page 38*)

**CHARTING** *a trip, F. C. Russell, president of the company which owns Aircraft Service, Inc., and C. F. Bacastow (standing), chief pilot, check map on board company's DC-3*



**CHECKING** *main gear. Aircraft Service, Inc., uses airline-type maintenance system*

**PRELIMINARY COST** *estimate of overhaul, such as this being done by Mallard Industries, should be prepared by the corporate-plane owner*

# Cost Estimates of Overhaul

*Plane owner's preparaton of overhaul estimate for preliminary work will be helpful in checking prices submitted by competitors in bid proposals*

by Willis L. Nye

Regardless of the excellence of maintenance and inspection of a specific air transport, the inevitable time always arrives when consideration for a major overhaul of the airframe and the engines of a corporate-owned air transport becomes a mandatory item of consideration. This involves considerable outlay of money in order that the reconditioning operation will prove satisfactory and permit safe operation for several thousands of hours after the overhaul has been accomplished.

Frequently, corporate owners have had to rely on the judgment of their pilot or maintenance mechanic. In certain instances these personnel may not be entirely familiar with the amount of work necessary to completely recondition an air transport and the cost that it entails. Usually, their guess will be on the low side of the final cost estimate; occasionally, on the high side. And the same erroneous concept may also be embodied in estimates obtained from various maintenance organizations

who may prepare optimistic proposals in order to obtain the work of reconditioning on a time-and-material basis instead of on a competitive basis. It is these erroneous concepts that make it advantageous for the corporate owner to prepare preliminary estimates of his own, and then submit proposals to reputable plane-reconditioning firms for their costs of the work to be done. Thus, by having his own estimate available when the bids for the work to be done are submitted, the corporate owner can at least exercise some judgment in deciding how the work will be awarded and on what basis.

**Work Award:** Whether the reconditioning work will be awarded on a time-and-material basis, a competitive bid, or a sliding-scale bid (wherein if the cost exceeds a certain amount, the customer pays for the extra work or if the work is less than anticipated, the customer receives a refund) is something that can be determined by the examination of the bids submitted by firms interested in doing the work. However, the preparation of an estimate by the corporate owner makes it possible to have a basis for negotiation of the work which is not possible if no knowledge of reconditioning work is at hand. At the least, it functions as a deterrent to high costs when the work is being prosecuted.

**The Estimate:** An estimate that deals with the reconditioning of an air transport is predicted on past performance of the work, the cost of direct and indirect material, the expenditure of direct and indirect labor, anticipated inspection discrepancies, and certain work operations and handling associated with this kind of work.

For each reconditioning operation, these labor expenditures are apportioned a specific number of direct man-hours. In turn these man-hours are added to the estimated man-hours to be expended for the whole reconditioning operation. Thus, by an evaluation of this data concerned with a specific overhaul project, an estimate may be compiled and an approximate cost be obtained for budgetary purposes. The following are the general items of work that require labor expenditure of one sort or another, but which must be completed in order to recondition the airplane. Unfortunately, certain items of work in this category must also be accomplished when routine inspection operations are to be performed. They may be considered as static to airplane maintenance, although of a preparatory nature in some instances. Although they vary for single, twin, or multi-engine aircraft, many are applicable to all air transports.

1. Handling and towing of aircraft into and out of the hangar and therein.
2. Use of tractor tug, crane, fork lifts, etc.
3. Inventory of equipment incoming.
4. Removal of loose, detachable, and emergency equipment.
5. Placement of handling tools, jigs, work platforms, etc.
6. Draining of fuel, oil, hydraulic fluids, alcohol, water, lavatories, etc.
7. Preliminary engine run-up and engine preservation.
8. Cleaning of airframe, engines, propellers, and parts.
9. Paint stripping.
10. Placement of jacks.
11. Fuel tank charting.
12. Machine-shop work.
13. Procurement of direct and indirect materials, parts, aircraft hardware, etc.
14. Supervision.
15. Preliminary inspection.
16. Work inspection.
17. Painting, stenciling, color coding, decalcomanias, etc.
18. Engine pre-oiling.
19. Fuel tank check after filling.
20. Reinstallation of loose, detachable, and emergency equipment.
21. Aircraft historical records.
22. License installation. Name plate modification, etc.
23. Mechanic follow-up cleaning.
24. Flight-line servicing after final inspection.

When preparing the estimate of a specific overhaul or airplane modification project, these items of direct labor expenditure are apportioned a certain number of man-hours. The apportionment of labor expenditure is based on past experience or what may be considered good judgement. Usually this amount of labor functions as the foundation on which to build the estimate to completion. Therefore, by proper evaluation of the labor to be expended, an approximate cost may be developed for budgetary purposes or for scheduling of the work.

There are two ways to apportion this work. In the first method, a specific percentage is added to the basic estimate to cover the overhaul work. The second method is to evaluate each item separately. Either way is satisfactory, provided sound judgement is exercised.

**Overhead Expenses:** Cost estimates must be prepared in such a manner as to reflect the true overhead costs of the facility which is to do the work. Wage rates vary from one facility to another and so does the overhead. In some instances, the overhead may be as low as 75% of each direct hour of labor expenditure. In other instances, it may rise as high as 150% of the labor hour. In dollars, the labor cost may range from $3.75 per hour to $5.50. For estimating purposes, an average cost of direct-labor expenditure of $4.00 per hour will be useful to apply. But it should be borne in mind that estimated labor hours and performance labor hours may be of wide discrepancy in total and this depends upon the work efficiency of the overhaul facility.

**Direct and Indirect Material:** In respect to the direct and the indirect material, at best some of the prognosticated costs may be known in advance of the preparation of the estimate and some may not. For cost of the airframe parts, reference may be made to past invoices for the same part or application may be made to the airframe manufacturer or to an airplane parts supply organization. For the indirect material, a specific percentage of cost may be determined based on the estimated direct labor costs.

When purchasing direct material, the invoiced cost will be the cost plus a percentage mark-up as profit to the supplier. A fair assumption of this mark-up may be made, provided the cost of the part is known in advance. This ratio may be used where parts are fabricated or must be made by local facilities.

**Basis of Estimates:** Estimates must be made before the work is committed to a specific overhaul facility. The method on which the contract is to be negotiated should be determined beforehand. Such items as the cost of direct parts enters into the negotiation as well as the cost of indirect material used to complete the project. In general, an overhaul contract is negotiated on the following premises:

1. Time and material in man-hours and material plus fixed sum or percentage of the total cost of the overhaul project.
2. Flat-rate basis predicated on an estimate and a lump sum price.
3. Time and material in man-hours guaranteed not to exceed a specified amount plus cost of material and parts. Necessary additional work subject to negotiation.
4. Fixed price plus a fixed fee.

**Soliciting of Quotations:** It is considered to be of conventional practice to solicit bids for the accomplishment of overhaul work. Such items as inspection discrepancies can be costed on the same basis

as the contract has been negotiated or by the allowance of a fixed amount of man-hours and a specific sum for parts replacement as a result of inspection discrepancies.

Items such as painting of wings, insignia, numerals, stenciling, placards, cleaning, washing, polishing, fuel-tank repairs, etc., are frequently quoted on a flat-rate basis. Engine build-up, engine removal, engine preservation, engine disassembly, propeller overhaul, propeller repair, 100-hour check of each engine are quotable on a flat-rate basis.

Other hidden costs in the cost of direct or indirect materials are known as the final acquisition costs. Acquisition costs include handling, binning, (surplus, material control, kardex records, inventory costs, packaging costs, etc.,) plus other overhead charges which must be expended before the parts or materials are installed on a specific air transport. If parts are to be purchased on a cost-plus basis, those hidden costs should be negotiated and applied as a percentage to the cost of the part as it is installed. These are all part of preliminary contract negotiations of the cost-plus variety. Flat-price contracts include these automatically.

**Man-Hour Costs:** Usually in a competitive bid, the lowest estimate (not necessarily the lowest in dollars) commensurate with the specification requirements and quality workmanship is made the basis on which a competitive bid is awarded. In this respect, mechanical personnel who are on a direct-labor status are subdivided into three classifications of hourly wages. For example, there are certain kinds of work performed on a flat-rate basis where only "C" class labor may be required. Thus, to award a contract on a straight hourly man-hour basis may be more expensive than having this same work done on a flat-rate basis.

Such work as removal of loose, detachable, and emergency equipment, disassembly, washing, cleaning, etc., may be done with personnel in the "C" class category, whereas engine work, instrument work, hydraulics, electrical, radio, etc., must be done by skilled technicians in the "A" category. In the finalization of the labor estimate, the sub-totals for the three categories of overhaul work may be made. The grand total is then obtained to show the estimated labor costs.

**Sales Taxes:** Sales taxes constitute a minor percentage of the cost of the overhaul work. These should be added at the taxable percentage to the direct and indirect materials as well as fabricated parts on the air-transport overhaul project. Usually, no sales taxes are levied on labor alone, but when a part is manufactured at the local facility, it is taxable at its selling price to the customer.

**Engine Overhaul Operations:** The man-hours presented in the following are approximate and will vary from one overhaul center to another. They may also vary with mechanical personnel, facilities to perform the work, availability of parts, test equipment, etc. Such factors always enter into the final labor costs. The following man-hour figures are those for a P&W R-2000-9 engine used on a DC-4 transport.

| *Engine Overhaul Components | Man-Hours |
|---|---|
| *Eng-driven Generator* | 16 |
| *Engine Starter* | 16 |
| *Tachometer Generator* | 16 |
| *Eng-driven Fuel Pump* | 4 |
| *Eng-driven Vacuum Pump* | 4 |
| *Eng-driven Hydraulic Pump* | 6 |
| *Prop Governor* | 16 |
| *Oil Pressure Relief Valve* | 2 |
| *Engine Removal* | 10 |
| *Reconditioning of Miscellaneous Parts* | 12 |
| *Cleaning Engine Parts* | 8 |
| *Engine Disassembly* | 24 |
| *Engine Build-up* | 75 |
| *Engine Preservation* | 2 |
| *Engine Pre-oiling* | 1 |
| *Engine Installation* | 31 |
| *Magnafluxing of Engine Mounts* | 2 |
| *Engine De-preservation* | 2 |
| 100-*Hour Engine Check* | 24 |
| **Propeller Overhaul** | |
| *Propeller Removal* | 2 |
| *Propeller Overhaul* | 45 |
| *Propeller Recondition* | 12 |

(**Man-hours for above work were obtained by means of a time-study operation at one facility and are not to be considered as the optimum that can be done or are they absolute.*)

The above man-hours are typical for aircraft having the R-2000-9 P&W air-cooled engine installed These man-hours are for a single-engine installation. When preparing an estimate for multi-engine aircraft, multiply these figures by the number of engines or propellers that must be overhauled.

**Preparation of Estimate:** Perhaps the important thing to remember is to itemize separately the work that has to be accomplished in the overhaul operation. Thus, the work to be done should be broken down substantially in the following order:

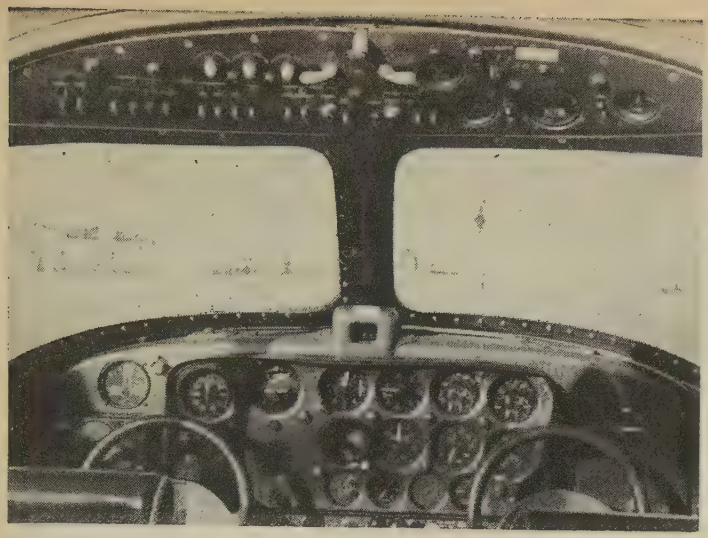
1. Engine and propellers.
2. Aircraft and engine instruments.
3. Flight and navigation instruments.
4. Nose wheel assembly.
5. Main landing gear assembly.
6. Hydraulic system components and lines.
7. Hydraulic system miscellaneous components.
8. Wings and center section.
9. Fuselage, interior, exterior.
10. Empennage, flight control surfaces, stabilizers.
11. Controls, control cables and systems.
12. Aircraft accessories.
13. Aircraft electrical system and accessories.
14. Radio and electronic equipment.
15. De-icer and anti-icing systems.
16. Heating system and components, and ventilation.
17. Loose equipment.
18. Emergency equipment and components.
19. CAA mandatory items.
20. Sheet metal repairs.
21. Flight and taxi tests.
22. Final inspection.
23. Inspection discrepancies.
24. Oil system and components.
25. Fuel tanks, fuel system, components.
26. Fuselage equipment, furnishings, galley, etc.
27. Preliminary items previously outlined.
28. Oxygen and carbon-dioxide systems.

After the estimated man-hours for the preliminary items, removal, overhaul, re-installation, testing, inspection, etc., have all been evaluated, then the total number of man-hours required to do the work can be roughly approximated. In addition, the anticipated amount of indirect labor, new parts, anticipated overhead costs as well as indirect material should be evaluated, plus other items of cost as stated. In the following paragraphs, a list of actual removal and installation man-hours for various components of the DC-4 are given. This should be of material assistance in the preparation of an overhaul estimate.

## COMPONENT REMOVAL & INSTALLATION MAN-HOURS FOR A DOUGLAS DC-4

| Components | Removal Man-Hours | Install Man-Hours | Total Man-Hours |
|---|---|---|---|
| *Carburetor* | 1.0 | 2.0 | 3.0 |
| *Carburetor Anti-Icer Manifold* | 0.8 | 1.0 | 1.8 |

(*Continued on page 43*)



# CAMAIR 480

**CAMAIR 480** *features airline-type arrangement with switches, rheostats, etc., mounted on overhead panel (above, left). Wing tanks on the twin-engine conversion of the Ryan Navion hold over 34 gallons each, bringing total fuel load to 108 gallons. The Camair 480 seats four, is powered by two Continental 0-470-B engines, cruises at 192 mph at 6,000 ft at 70% of power*

A new twin-engine conversion of the popular Ryan *Navion* recently was announced by the Cameron Iron Works, Inc., a leading oil tool and equipment company located at the Municipal Airport at Galveston, Texas. Called the CAMAIR 480, the new twin conversion is powered by 240-hp (at 2600 rpm) Continental 0-470-B engines with constant-speed, controllable, all-metal full-feathering propellers. The new Continental 0-470-B engine offers an integral oil cooler with no external lines, direct mounting accessories and compact design for easy maintenance. Features of the CAMAIR 480 include an increased wheelbase to provide greater taxiing stability and superior ground handling characteristics, stainless steel augmenter tubes which provide engine cooling without the need for cowl flaps, and wing tip tanks which add lift. The cockpit features an airline-type arrangement, with switches, rheostats, etc., mounted on an overhead panel, thus providing an uncluttered main panel with plenty of room for instruments and radio equipment. The cockpit also offers an arm-level control quadrant, individually actuated toe brakes, and non-glare indirect panel illumination. Custom upholstery and foam rubber seats are standard, as are 6-ply tires, Goodyear main wheels and single disc brakes.

Cameron Iron Works, Inc., only recently expanded its operations by adding a division to serve the aviation industry. CAMAIR offers overhaul, repair, modification, maintenance and conversion of aircraft, parts assemblies, tools, dies, jigs, etc. The CAMAIR 480 is one of the first conversions developed by the company, and from all reports it promises to provide the flying executive with a safe and highly efficient airplane to meet his business needs.

**Performance**

| | |
|---|---|
| Gross Load | 3,930 lbs |
| Cruise (70% at 6,000) | 192 mph |
| Rate of Climb SL | 1,750 fpm |
| Rate of Climb SL (one eng) | 450 fpm |
| Service Ceiling | 22,000 ft |
| Service Ceiling (one eng) | 8,000 ft |
| Range | 900 mi |
| Wing Loading | 21.3 lbs/sq ft |
| Power Loading 480 hp | 8.2 lbs/hp |
| Useful Load | 1200 lbs |
| Fuel | 108 gals |

**PARTICIPANTS** *at the Flight Operations Round Table on maintenance procedures included (left to right) Bill Hall, U. S. Aviation Underwriters; Bill Person, Flight Safety Foundation; Wm. N. Horan, Great Lakes Carbon; Leonard Lee, Continental Can; Charles Weite, Atlantic Aviation; Mel Rummel, Flight Safety, Inc., who served as Moderator of the meeting; A. M. Bertolet, Reading Aviation Service; R. S. Northington, Piedmont Aviation; George Moore, Butler Aviation; and Gerald D. Brown of Sperry*

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

*AUGUST 1954* — *Hotel Shelburne, New York*

# MAINTENANCE PROCEDURES

**Moderator Melville S. Rummel** (*Mgr., Maintenance Engineering, Flight Safety, Inc.*): "Our discussion today deals with maintenance procedures for business aircraft. Economically, aircraft maintenance has become big business, especially when one realizes that in many cases maintenance accounts for a good 25% of the total operating cost. In fact, in some instances it is the largest individual cost in the aviation-operation's budget.

"*Safety cannot be over-emphasized either, and to date the safety record of business aircraft is most enviable. However, there have been accidents and I wonder if any of the fatalities that have occurred could have been attributed to mechanical failure, to improper maintenance, or perhaps a combination of both. Bill Person, does Flight Safety Foundation have any information on that score?*"

**William P. Person** (*Mgr., Air Transport Div., Flight Safety Foundation*): "Not specifically, Mel. I would like to say this, however, one of the big problems in the business-aviation field concerns the lack of interchange of maintenance experience information. The best example of an interchange of such information is the daily mechanical bulletin that is put out by the CAA and copied for members of ATA. This bulletin sums up all the mechanical problems of the various scheduled air carriers and often determines a possible pattern of mechanical difficulties. In the business-aircraft field, however, it is very difficult to correlate such information. A corporate pilot may have a problem, but few other pilots ever get the information on it. From a maintenance or experience interchange point of view, this is very poor because it means we have to continually dig to discover the circumstances that surround a particular incident. Were these facts readily available, they would be helpful to all business pilots.

"Maybe NBAA could play a part in the solution, or perhaps Flight Safety Foundation could, but whatever organization comes up with a plan for this interchange of information, it would be adding safety to business-aircraft operation. Fred Lee of the CAA has offered to help with this problem, but it will require the cooperation of all.

"The other problem involves the maintenance that confronts the average business pilot, whether he operates a fleet or a single airplane. In many instances he doesn't have a

**"FIXED** *points of time for inspection are necessary," reported A. M. Bertolet (right)*

## ROUND TABLE PARTICIPANTS

*M. S. RUMMEL, Manager of Maintenance Engineering for Flight Safety, Inc., served as Moderator of the discussion. Mr. Rummel joined Flight Safety, Inc., in 1935 after having served as sales engineer for Bendix and, prior to that, he served as engineer for Pan American World Airways.*

*ALFRED M. BERTOLET, president of Reading Aviation Service, has been actively engaged in flying and associated fields since 1931. He organized RAS in 1941.*

*GEORGE W. MOORE, general manager of Butler Aviation at La Guardia Field, was a Naval aviator during World War II. He became affiliated with Butler in 1953.*

*CHARLES WEITE has been Aircraft Service Mgr., for Atlantic Aviation, Teterboro, since 1952. He began his mechanical training in 1936; his flight training, 1937.*

*WM. N. HORAN has been a pilot for Great Lakes Carbon Corp. since 1951. He previously served as an enginering test pilot on the Corsair for Chance Vought.*

*W. R. HALL is manager of Eastern Dept. of U. S. Aviation Underwriters, Inc. During the war, Bill was a Pilot Officer in the Royal Canadian Air Force.*

*ROBERT S. NORTHINGTON has been Vice President & Director of Piedmont Aviation since 1947. He is past president of National Aviation Trades Association.*

*LEONARD J. LEE is Chief of Maintenance and Chief Inspector for the Air Transport Dept. of Continental Can Co., Inc. He holds an A&E, Instructor, DAMI.*

*GERALD D. BROWN began his aviation career with Gates Flying Service in 1929. He has been aircraft maintenance supervisor for Sperry Gyroscope since 1940.*

*WILLIAM P. PERSON, a former Captain with American Airlines, is now the Manager of the Air Transport Division of Flight Safety Foundation.*

current aircraft manual . . . . and a maintenance manual is an even greater rarity. Many operators do not have the proper maintenance forms —for example, pre-flight forms or 100-hour check forms that are specific. The CAA puts out a regular 100-hour check form, but it is not complete enough. Actually, it is just a guide and should be enlarged upon.

"Also, I don't believe many operators have established a definite maintenance pattern. Through previous experience, an airline is able to set up a regular maintenance pattern and is able to determine how much maintenance work is going to be necessary, and when.

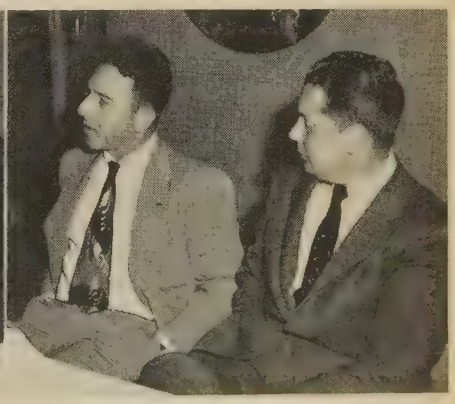
"The problems of the business pilot loom large when you consider that he has to operate an airplane at the beck and call of the boss. All of which brings up the point of progressive or equalized maintenance, and how important it is to his particular operation. Economically, progressive maintenance is very important to the airline people. From an aircraft utilization standpoint, due to the characteristics of the corporate field, it would appear to be of even greater importance to business-plane operators. After all, the business-plane pilot has to have his aircraft ready and able to go whenever there's need of it. This means that equalized service or progressive maintenance is extremely important. I personally feel it would enhance the entire corporate-plane field if the operators could get their maintenance on a progressive or equalized service basis. That way they would be able to get full utilization of their aircraft. Such organizations as Flight Safety, Inc., make a business of developing a complete service plan tailored to the individual operator's need."

**Mel Rummel:** "*Perhaps now we should hear from some of the operators themselves on how they've tackled their maintenance problems, how they have set up their organization and what sort of program they are using.*"

**William N. Horan** *(Reserve Capt., Great Lakes Carbon Corp.)*: "We try to keep our maintenance as simple as possible. We operate three aircraft—two DC-3's and one A-26—and I'd say we average about 120 hours a month on all three. We employ three full-time mechanics, and their duties are to do 100-hour inspections, perform minor modifica-

**"WE RUN** *our own inspections as per our own forms," stated William Horan (right)*

**"PREVENTIVE** *maintenance is what we try to sell," said R. Northington (left)*



**"REGARDLESS** *of size, engines, we run checks each 30 hours," said G. Brown (left)*

**"WE HAVE** *eliminated the 100-hour inspections in favor of time inspections on all of our aircraft except the D-18's," reported Leonard Lee (center) of Continental Can*

tions, engine changes and paint jobs. All other maintenance, installations, etc., are farmed out on the basis of price priority. For a 100-hour inspection on the A-26, we simply take it off schedule. In performing the check, the men work the plane over by the various components: one man may work on the tail section; one man may do the left engine; the other man, the right. In that way, in the event we get a phone call for a quick trip in the -26, the men simply button it up again, write up what they have completed, and the plane is ready to go.

"With the DC-3's, however, they are completely off the schedule until the 100-hour is completed. Of course, between 100-hours the men do routine maintenance as per the pilot's crab items.

"The other thing we do is whenever we have a trip out of the country—the northern part of Canada, Newfoundland, or down through the Carribbean, we put a maintenance man aboard the airplane. We do that because we don't feel we can trust some of the people way off in the wilds.

"Substantially, that's the way our maintenance is run. Generally, we use the 100-hour inspection form, and the only progressive maintenance we do is on the A-26—which is an attempt to complete the 100 all at one time."

**Mel Rummel:** *"Are these forms that you use your own and do they include the 100-hour?"*

**Wm. N. Horan:** "We do our own inspection as per our own forms. While the CAA form is the standard that is set up, we use our own forms because we have so many more components to check—the autopilot, the electrical system, etc. Also, we take all of our radio gear completely out of the airplane at least once a year. Everything comes out of the racks and is checked, even though the stuff could probably run two or three years without any trouble. Anything that looks the least bit suspicious is completely overhauled."

**Leonard J. Lee** *(Chief of Maintenance, Continental Can Co., Inc.)*: "Our operation is a little different from the average in that we have a complete maintenance base. We're not only operating for our own company but we are also operating a fixed-base operation for those who are our tenants in the hangar. Over a period of nine years in the business, we have developed some rather definite ideas and systems with regard to maintenance. Everything we do is according to our own book. We have our own maintenance manual where everything is spelled out in black and white for the man on the floor of the hangar. On three of our airplanes we have eliminated 100-hour inspections in favor of time inspections. However, our D-18's are still getting routine 100-hour checks. We have found that they require it. But on our larger aircraft we are doing the inspections on a time basis. Due to our scheduling problem, we have a definite turn-around inspection that practically amounts to a 100-hour engine inspection everytime the airplane is in the hangar. We run two 35 or 40-hour trips a month to the west coast or up to northern Canada, and when the airplane comes in, we do a 100-hour or what we call an engine and airplane turn-around check. Men are specifically assigned to certain areas or portions of the airplane that experience has shown us to be critical.

"Twice a year we take each airplane out of service for one week, once for an annual re-licensing and once for a mid-year inspection. We have come to feel that you can do more damage to the airplane by pulling it apart every hundred hours than you do in normal flying. We check door clearances and everything else twice a year, and we have a definite schedule on it. Our radio shop pulls every bit of radio equipment and gives it a six-months check, all on a time basis. By that I don't mean that they do everything every six months—we may have half a day on the airplane, so we catch the wheels that day and test the gear another day. But we don't schedule it out for maintenance and, therefore, the airplane theoretically is available to management 24 hours a day except during those periods of the year when we schedule it out. We keep in pretty close contact with management, and when we know none of the departments will use the airplane for the day, we have that day for inspection. The whole idea has worked out fairly well. We have not had over three delays due to maintenance in several years."

**Mel Rummel:** *"Jerry, do you have anything you'd like to add regarding your procedures at Sperry?"*

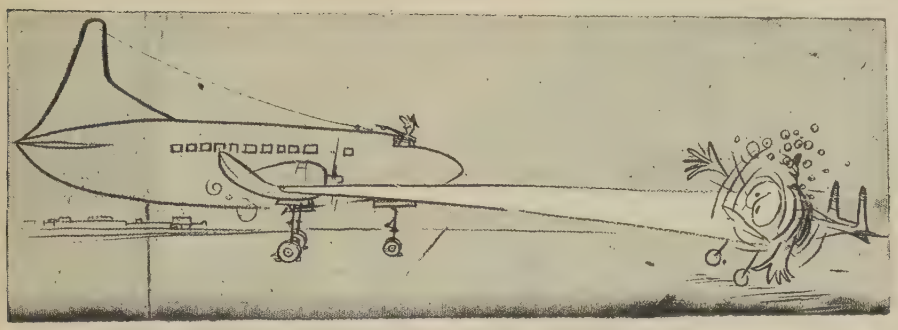
**Gerald D. Brown** *(Maintenance Supervisor, Sperry Gyroscope)*: "Our set-up probably is unique in that it is entirely different from the airlines, the military or even business-aircraft operations. Essentially, we are a flight research department. However, we do have very formal inspection and maintenance procedures which have been established as a result of our experience over a period of 15 years. Today, we maintain two hangars at MacArthur Airport and presently have about 14 or 15 aircraft, some of which are loaned to us by the military, while nine of them are company-owned. Regardless of size, number of engines or horsepower, we run periodic inspections on all airplanes every 30 hours. We run the 30, 60, 90 so-called intermediate checks and then the 120-hour which is the first of the major inspections. We repeat this process up to 240 which is the second of the heavy or major inspections. All this continues right on up to either engine overhaul or annual certification. In effect, we are running a preventive maintenance check every 30 hours. Of course, on our military aircraft we comply with all military inspection procedures or Tech Orders.

(*Continued on page 30*)

# Performance PITFALLS

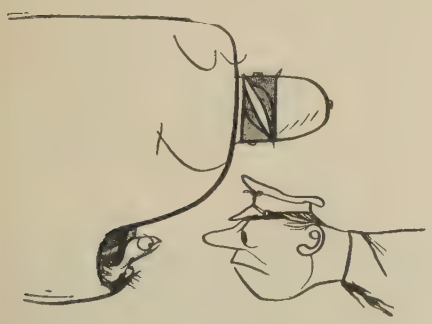
## from the Files of the Flight Safety Foundation

by Jerome Lederer and Robert Osborn



### USE OF LANDING LIGHTS

An unusual incident was recently experienced at the Chicago Airport. During the course of our landing on Runway 22L at night and prior to touchdown, the pilot of an airline Convair that was on the ground and facing our approaching aircraft, turned on his landing lights blinding us completely. Fortunately, the landing was made without difficulty, but incidents of this type could have serious results. Let's all be as considerate as possible in the use of our landing lights.



### WHAT A PRE-FLIGHT!

Some rather enterprising birds at the Chicago-Midway Airport built nests in both carburetor air scoops of a company plane during a two-day stay-over in Chicago. Left engine backfired and lost power on take-off, but the aircraft returned to the field without further incident. From this it would seem advisable to remind pilots to preflight the scoops for evidence of a resident.

### NEAR-MISSES

During the past 10 years there have been 15 collision accidents involving air-carrier aircraft, eight of which happened near the airport. Rather recently we have had two accidents—one fatal and one serious—involving small aircraft becoming involved in the wake of a larger aircraft. The statistics on near-misses in the vicinity of airports are much harder to establish because many of them are not reported. However, the best information available is based on incident reports compiled by the CAA regional offices for an 11 months period in 1949. The total number of reported near-misses for the seven domestic regions during that period was 292. It should be assumed, however, that the actual number was much greater because we all know that many of these incidents are not reported to CAA. Of these, 219 or 75% occurred in the terminal areas. Approximately 66% of these terminal area near-misses occurred when the flight was being made *without* a clearance. Now that does not necessarily mean that it was in violation of any regulation or procedure because in many cases, perhaps in most cases, a clearance was not legally required. About 44% of these latter incidents occurred in IFR or questionable VFR weather conditions.

### ANTI-COLLISION LIGHT

We have had a recent report from an airline captain who requested the SFO Tower to track one of his trips by radar. The aircraft was equipped with the red rotating beacon. The tower complied with this request and reported that at a distance of 40 miles the beacon was still plainly visible; however, it was lost to sight at a 45-mile reading. But all other running and navigational lights had disappeared before a reading of 20 miles. The SFO weather was reported as clear and 15 miles.

### COCKPIT SIGNALS

On one of his first full-gross take-offs, a new First Officer *thought* he heard the Captain call for gear up, so he reached for the gear actuating control. Fortunately, the Captain spotted his movement in time to prevent his upping the gear before the aircraft was airborne. Watch for this sort of thing all the time, but especially when flying with new personnel.

An additional suggestion on the gear up-down signals might be in order. During a recent tour of active duty, it was found that even when both hand and voice signals were required by the pilot, there sometimes was a misunderstanding by the copilot. The copilot may mistake a certain gesture or think he heard a command before executing it. If the captain hears the First Officer giving a command without having given it himself, he will realize that the First Officer is in error and can prevent the action. Where we contend with high noise factors in the cockpit, the repetition of all commands will greatly benefit in reduction of cockpit errors.

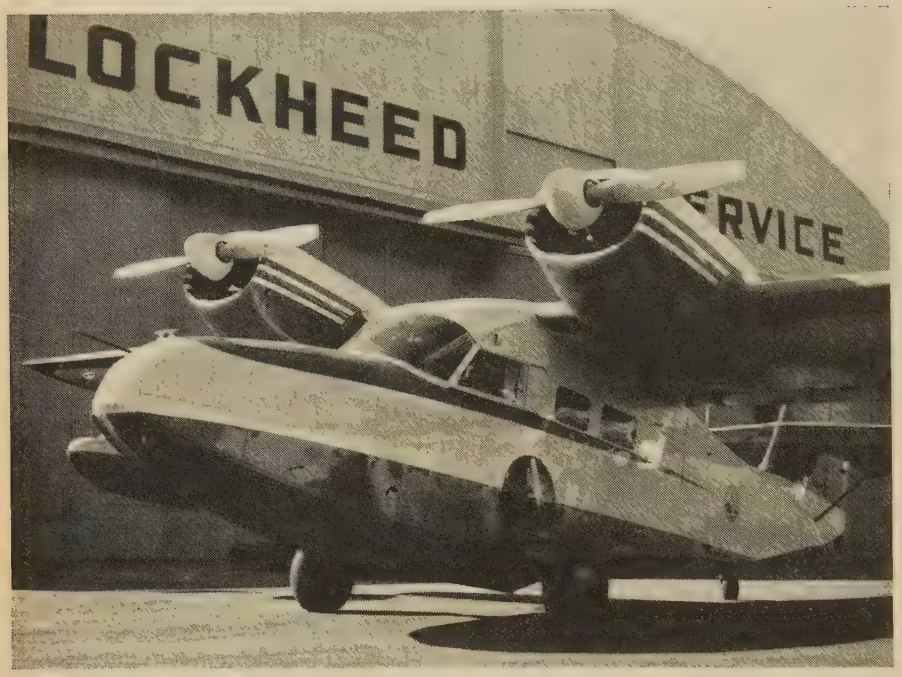
### COLLISION AND PAPER WORK

To reduce the hazard of collision in flight, many pilots, and the policy of some operators, prohibit paper work in the cockpit during climb and descent. Yet there is often a forgetful urge to do this in spite of good intentions.

*Fix*: Print on every form or on the clipboard, "Not to be used in Climb or Descent."

# SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS




**LOCKHEED AIRCRAFT SERVICE** *has sold its rights to Grumman Widgeon conversion kit to Link Aeronautical. Modification calls for Lycoming 260's (above) instead of Ranger 200's*

## Link Aeronautical Buys LAS Widgeon Conversion Rights

*Endicott, N. Y.* Link Aeronautical Corporation has purchased the design, manufacturing and sales rights, along with parts fabrication tooling and complete inventory of Lockheed Aircraft Service's Grumman *Widgeon* conversion kits. First to design and develop a practical method of installing Lycoming 260-hp engines in the Grumman G-44 and G-44A *Widgeons* to replace the *Widgeon's* original 200-hp *Ranger* engines, Lockheed Aircraft Service foresees an extensive market for this type of modification in aircraft operated by companies for transportation of executives and key personnel.

In addition to supplying the LAS-designed conversion installation to owners and operators of *Widgeon* equipment, Link Aeronautical Corporation plans to maintain a stock of major-overhauled and modified *Widgeons* ready for immediate delivery, with only the buyer's exterior paint color and design to be applied. *Ranger*-powered *Widgeons* will be accepted in trade by Link as of the date the Lycoming-equipped Grumman is set for delivery.

The additional horsepower derived from the Lycoming engines together with the exceptionally clean cowling and upper nacelle modification designed for smoother air flow over the upper wing surfaces has achieved a decided increase in performance. *Widgeon* performance data works out this way:

| | Lycoming 260 | Ranger 200 |
|---|---|---|
| Max Speed (SL) | 187 mph | 164 mph |
| Cruise (75%) | 171 | 150 |
| Cruise (62½%) | 157 | 138 |
| Cruise (62½-6000) | 164 | 146 |
| Rate of Climb | 1750 fpm | 1,000 fpm |
| Climb to 10.000 | 8 min | 15 min |
| Service Ceiling | 18,000 | 15,500 |
| Take-Off Run | 640 ft | 895 ft |
| Glassy Water TO | 16 sec | 25 sec |
| Landing Speed | 63 mph | 58 mph |
| Range with 45 min reserve | 600 miles | |
| Gr. Weight | 5,000 lbs land<br>4700 lbs water | 4500 lbs |

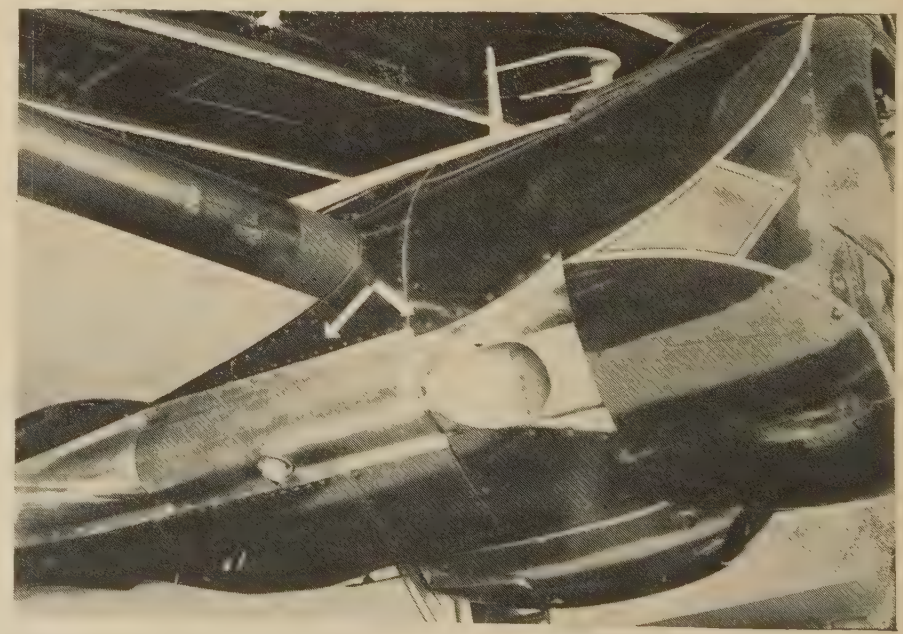
Link Aeronautical Corporation's headquarters are at Tri-Cities Airport, Endicott.

## New Lodestar Heater System Engineered by Mallard, Inc.

*Stratford, Conn.* Cognizant of the problems the standard exhaust and heater system installation on the *Lodestar* has given operators, Al Zotack, chief pilot for Kollsman Instrument Corp., recently came up with a practical manifold and heater system for his company's *Lodestar* which eliminates the old worries about ball joints becoming worn and sections loosening. Working with Mr. Zotack's basic idea, Mallard Industries, Inc., did further planning and recently completed the necessary approval engineering and installation of the new system.

The standard ball-joint type exhaust collector assembly and the long stacks were removed and replaced by a relatively inexpensive and readily available sleeve-type collector ring with a short stack. The original tailpipe and intensifier tubes on the *Lodestar* were removed and replaced by a combustion heater in each engine nacelle. Heater controls and a ground blower also were incorporated in the system.

A weight saving has been made possible



**MALLARD** *and Kollsman chief pilot Al Zotack developed new heater, manifold system for Lodestar. Short stack replaces long one, combustion heater is installed in each nacelle*

by the new system and, in addition to eliminating the inspection and replacement of intensifier tubes, the new heater installation provides a positive safeguard against intensifier tube failure and the consequent carbon monoxide entering the cockpit and cabin through the heating system.

Mallard's installation of the new heater has been approved by CAA, and flight tests have indicated that it is more efficient and results in a lower noise level in the cabin than the old system.

## Southwest Airmotive Rated No. 1 Service and Gasoline Dispenser

*Dallas, Texas.* Gasoline is a no-small-quantity deal at Southwest Airmotive, Love Field, nor is it the only service provided the customer who drops his gear on the 30-acre concrete welcome mat for aircraft. In the past year, Southwest has pumped some 3,500,000 gallons of gasoline and 200,000 quarts of oil in serving transient and local aircraft. Other offered services range from baby sitting to kennel keeping, but probably one of the most appreciated services as far as pilots and flying businessmen are concerned is the button-sewing ability of popular Lorraine Sanders, assistant treasurer in charge of all gasoline and ramp transactions, who doubles in class as Southwest's official lobby "hostess." Miss Sanders keeps needle, thread and spare buttons handy for such emergencies, and there have been many of them. Her counterparts in the transient service department are C. G. Killingsworth and his assistant, Ed Tresp, who direct all the refueling and hangar storage at Southwest. Both men often find themselves doing such other odd jobs as grocery shopping for some executive aircraft, stashing away a Neiman-Marcus hat delivered to them for safe-keeping for some airplane-owning executive's wife, helping a visiting pilot locate a former girl friend's telephone number or squeezing a customer into a hotel in the midst of a full-house downtown convention.

Service is, indeed, standard operating procedure at Southwest, and pumping over three million gallons of gasoline of all octane ratings (including the jet JP-4) is just a portion of that service.

## Champion Develops New All-Weather Spark Plug

*Toledo, Ohio.* Champion Spark Plug Company has announced a new all-weather plug (3/4"-20) for use in large multi-engine executive aircraft. Designated the Champion R115, it is now CAA-approved in the R-1820, R-1830, R-2000, R-2800 and R-3350 engines. The new plug's shielding barrel and connector design provide uninterrupted insulation from ignition lead to spark plug, thereby eliminating any flash-over resulting from moisture and/or altitude. Conversion from the standard 5/8"-24 shielding barrel types (R37S-1, etc.) is simple, requiring in most cases only the replacement of elbows and lead connectors. The new plug is available through Champion Aviation Distributors.

## ....in the Business Hangar

Aerotron Radio Company, Tulsa, Oklahoma, recently installed a Flite-Tronics MB-3 Marker Beacon receiver and a CA-1 Audio Distribution amplifier in the Williams Brothers Company *Twin Bonanza.*

A Barkley Grow owned by T. J. Smith is now in the final stages of interior conversion and exterior painting at Mallard Industries' maintenance and overhaul hangar.

A Douglas B-23 owned by the Pittsburgh Consolidation Coal Company is in the process of modification at AiResearch Aviation Service, Los Angeles. In addition to the installation of a custom interior, the B-23 is getting seven picture windows, complete rewiring, a new heater and a three-color exterior paint job.

D. L. Gibson, chief pilot for Spencer Chemical Company's Twin Beech, has had the ship at Horton & Horton, Meacham Field, Fort Worth, for a complete custom interior.

Ralph Davis, pilot of the TVA *Lodestar,* recently brought the plane to Remmert-Werner for new radio equipment. Installation consisted of a Collins 17M VHF transmitter, a 51R-3 VHF receiver and a 51Z Marker receiver.

A Grumman *Super Widgeon* converted by the McKinnon-Hickman Company recently was delivered to Billy Parker of Phillips Petroleum Co., Bartlesville, Okla. Handled by Jim Welsch Aircraft Sales, of New York, McKinnon-Hickman Company *Super Widgeon* conversions have been sold to West Virginia Pulp & Paper Co., Gannett Publishing Co., Everbrite Electric Sign Co., Miller Brewing Co., and Knox Gelatine Co., as well as several other companies.

G. F. Ludden, pilot for Central Soya Company, Fort Wayne, Indiana, recently brought his company's *Lodestar* to TEMCO Aircraft's Greenville, Texas, modification and overhaul center for a complete reseal of integral fuel tanks and bat wing modification.

Harry Dawson and Bill Krell, pilots for Rockwell Spring and Axle Co., brought their company's DC-3 to Aerodex for a new paint job. Home base for the -3 is Coraopolis, Pennsylvania.

Chief Pilot E. C. Spencer of the Murray Corporation of America, Detroit, had his company's DC-3 at Qualitron, Inc., Burbank, for installation of a Bendix DME-5A system, a Collins 51R VHF navigation system and a new antenna system. Spence is also his company's NBAA representative.

Kurt Heilbroun and George Brown made Reading, Pa., their headquarters while Reading Aviation Service did major engine and gas tank work on their Philadelphia "Evening Bulletin" *Lodestar.*

One of Ohio Oil Company's PV-1's has been in the Grand Rapids hangar of Lear Aircraft Service Division for installation of an L-5 autopilot with approach coupler and automatic altitude control.

General Mills has added a Flite-Tronics MB-3 Marker Beacon receiver and a CA-1 Audio Distributor amplifier to its Aero *Commander.* Installation was made by Minnesota Airmotive, Inc., at Minneapolis. Bill Stone is pilot for General Mills, Inc.; H. J. Nystrom is Chief Pilot, and G. C. Ballhorn is NBAA representative.

Visitor on the ramp at Aerodex, Miami, was a De Havilland *Dove* owned by Lyons, McCord and Logan of Shreveport, La. Capt. Evan Davis brought the *Dove* in for ground service.

Bailey Case, chief pilot for AVCO Manufacturing Co., brought the company *Lodestar* to Reading Aviation Service for radio repairs and to go over requirements for a complete rewiring job of all electronic equipment in the airplane.

# Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.
*(formerly Corporation Aircraft Owners Association)*

**National Business Aircraft Association, Inc. is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.**

## DC-3 Rudder Modification Engineering Data Free To NBAA Members

Through the generosity of NBAA-member, Esso Shipping Company of New York, development and engineering data for reworking the DC-3 rudder now is available *free of charge* to all NBAA DC-3 owners who request it directly from National Headquarters.

Esso Shipping Co., through Col. E. W. Estelle, Manager of the Aviation Department, initiated the research and development work on the DC-3 rudder which led to CAA certification on May 12, 1952, permitting 1350 hp per engine on take-off. In order to reduce the control forces, the rudder modification was deemed necessary with the increased take-off. Also, this change greatly minimized the possibility of rudder lock under marginal flight conditions.

A letter just received from Esso stated that NBAA would be "pleased to learn that we (Esso) have now carried this development a step further and have secured gross take-off loading in excess of 26,000 lbs. We believe it would be of general interest to other operators of Douglas DC-3 airplanes to have the opportunity to operate with the same increased gross load as well as increased take-off power of 1350 hp per engine."

NBAA wishes to commend Esso for their progressive action and to express appreciation for their cooperation in this matter.

## Lodestar Bat Wings Removed

"Torch" Lewis, Chief Pilot for NBAA member, Thatcher Glass Manufacturing Inc., sent us valuable information recently which we are certain will interest *Lodestar* operators. We quote from Torch's letter:

"A few months ago I saw the *Lodestar* belonging to the Mabley Paper Bag Co. of West Monroe, Louisiana. This *Lodestar* had the bat wings removed and Pilot Elton Rust explained to me how it was accomplished. We went back to Elmira and did it. Total Cost—less than $25. Total airspeed gain—8 to 10 mph. Effect on flight characteristics—negligible.

"The so-called bat wings (extensions, trailing edge) were originally put on the *Lodestar* by Lockheed to eliminate a "stick walk" or buffeting condition prevalent in some *Lodestars*. According to Lockheed engineers, it did not eliminate the condition but did improve it to the extent that it was incorporated as a basic airframe component. The bat wings removal is accomplished by merely drilling out the rivets and pulling them off.

"The next step is to figure how much weight must be placed aboard the *Lodestar* in the rear cabin area so as to bring the cg back to its rearmost approved take-off position. This, of course, will vary with each plane. In our ship we put eight 50-lb. sandbags in the back and four more in the aisle between the rear seats. Our gross take-off weight with ballast was 18,029 lbs. CAA Inspector Games flew the test hop for approval and I rode as copilot. On Lear's and Elton Rust's recommendation, we took off with 10° of flap compensatory for removal of the trailing edge extension. We have since found that 7° or 8° is sufficient.

"After a normal take-off, we climbed out to altitude where we stalled the ship first in clean configuration, then with gear and flaps extended (20°, 40°, 60°,-full). After this we dove the ship to (280 mph) redline. Not once during the test (nor in the nearly 200 hours since) did we experience any unusual or unpleasant flight characteristic of any nature whatsoever. Our airspeed has increased 10 mph which is worth $25 of anyone's money.

"The CAA approval reference to be put on form 337 is as follows: Lockheed *Lodestar* 18-56—Remove Trailing Edge Extensions Req. Equipment No. 104A of Aircraft Specifications A723 Revision 13. The approval is only on an *individual* basis however, and each *Lodestar* must be done *separately*."

## NBAA Southwest Regional Meeting

One of the most successful and well-attended NBAA-sponsored Regional Meetings of business aircraft owners and operators to date was held recently in Dallas, Texas, at the Hotel Adolphus. Over 115 NBAA and other representatives from the Southwestern area, including several from California, were on hand to participate in the afternoon program and dinner.

George Vaughan, Chief Pilot, Phillips Drilling Corporation, and NBAA Southwestern Representative, welcomed the attendants. The meeting was chaired by NBAA Vice Chairman, Henry W. Boggess, Director of Aviation for Sinclair Refining Company. The program was primarily devoted to a round table discussion of aircraft and helicopter designs for business use, financing and production, and specifications. Mr. R. G. Ervin, Jr., Assistant Contracts Administrator of NBAA-member Bell Aircraft, outlined the various uses of the helicopter in business, described some of engineering problems, and forecast the potential value of the helicopter in the expansion of business flying. Buck Pettit, Sales Manager for NBAA-member Aeronca Manufacturing Corporation, displayed the model of their business airplane, reviewed the development of the design, and discussed operational specifications, costs, and prototype production problems. Russ Bierrman, Chief Controller for the Dallas CAA Tower, pointed out some of the problems in the Dallas area, described pending changes in air traffic control procedures, and offered constructive suggestions for improving contacts with controllers. Cole H. Morrow, NBAA Board Chairman, reviewed the NBAA's efforts to develop basic specifications for an "ideal" business airplane, the results of the survey conducted in 1952, discussions with interested manufacturers and the present status of their design and production plans, cost of a business airplane, and so on.

The question and answer period following each informal presentation was interesting with considerable audience participation. Like all other meetings of this nature, once it was underway it was most difficult to cut it off.

NBAA has sponsored similar meetings of business aircraft operators in St. Louis, Detroit, Cleveland, Chicago, Dayton, Toledo, Denver, Los Angeles, Bridgeport (Conn.) and Cincinnati. Wherever these meetings have been held, a local group usually is formed which meets every month or so to discuss special problems arising in their day-to-day operations, thus getting the benefit of others' experiences.

## NBAA Member Receives CAA Award For Aero Contributions

Michael C. (Mike) Murphy, Manager of the aviation department of NBAA-member, Ohio Oil Company, Findlay, Ohio, was recently presented with the honor award of the Civil Aeronautics Administration "in recognition of his solid contribution to aviation." The presentation was made by CAA Administrator, Frederick B. Lee. NBAA's Executive Director attended the ceremony.

A high tribute was paid to Mr. Murphy by Administrator Lee, who reviewed his career and spoke of his many achievements in the field of aviation. He read the full text of the citation in which is recorded the CAA's pleasure in presenting Mr.

Murphy "with this commendation—veteran of wide aviation experience, outstanding instructor, flight entertainer and executive pilot, continuously promoting civil aviation."

At the outset of his remarks, Mr. Lee said the Ohio Oil Company "is really a model in its application of the use of aircraft for business purposes." He commended the company highly upon its leadership and foresight in this field.

J. C. Donnell, president of the Ohio Oil Company, also paid tribute to Mr. Murphy's career and his service to aviation.

The Ohio Oil Company won an NBAA Meritorious Award last year for flight proficiency and safety, having flown over 5,000,000 plane miles without accident. The company operates 17 multi-engine and single-engine aircraft strictly for business transportation.

**CAA** *Honor Award was presented to Mike Murphy (right) by Administrator F. Lee*

## Member Describes DC-3 Emergency

NBAA member, Gaylord Container Corporation of St. Louis, Mo., has written concerning a recent emergency which occurred in their DC-3 operation. We believe the contents of this letter from Chief Pilot Lea Dorrance are so important that we are quoting verbatim:

"We just had an emergency on our DC-3 which was entirely new to me and, as far as I know, is not covered in any of our manuals.

"In practically all of the executive aircraft, the feathering system is actuated by a relay solenoid, and is not fused, as per CAA.

"A few minutes after take-off our left propeller automatically feathered, and then immediately started unfeathering. We did everything we knew about the condition—pulling off prop control, throttles and mixture controls. This helped, and upon landing, the engine operated normally, so we taxied back to the hangar. The electrical department checked over the complete circuit and found what we thought was a malfunctioning actuating button. This button was replaced, and another test hop was made, taking all precautionary measures we could think of. Approximately 1,000 feet from the boundary of the runway, the left prop again feathered.

"This feathering and unfeathering continued while we made a circuit of the field, and another successful landing was made. Under this pressure, neither myself nor my copilot (who is also a first pilot) could think of anything to do to stop the feathering.

"We have now worked out an emergency procedure to take care of such a situation, and thought perhaps you would be interested in passing it along to other pilots. By cutting off the generators, and then the electric master switch, the engine governor will take over and operate the engine normally. Great care must be taken on landing to be sure the engine does not surge when coming out of feathering position, if our procedure is not followed.

"It has also been brought to my attention that these solenoids are never inspected. We have now set up a maintenance policy covering this. All solenoids will be removed and inspected during the annual inspection."

## NBAA Chairman Demonstrates VOR/DME accuracy to ANDB

In connection with the VORTAC Committee (ANDB Special Committee No. 1), NBAA Chairman, Cole Morrow, recently demonstrated to ANDB representatives at Indianapolis just what could be obtained in the way of navigation accuracy and performance, utilizing standard commercially available low-cost radio equipment. The demonstration was flown by Morrow in his own personal *Bonanza,* and we understand the ANDB representatives were impressed.

## Olin Industries and Mathieson Chemical Announce Merger

Stockholders of Olin Industries, Inc. and Mathieson Chemical Corporation, both NBAA member companies, voted in special meetings at East Alton, Ill. and Saltville, Va. recently to approve the merger of the two companies to form a new corporation, Olin Mathieson Chemical Corporation. The new company will be one of the nation's important diversified processing and manufacturing enterprises with total assets of about $500,000,000 and sales of over $500,000,000.

The exact date upon which the merger will become effective will be announced shortly, according to John M. Olin, president of Olin Industries and Thomas S. Nichols, president and chairman of Mathieson. After the merger, Mr. Olin will become chairman of the board of Olin Mathieson and Mr. Nichols will become president. John W. Hanes, financial vice president of Olin, will become chairman of the finance committee of the new corporation.

A joining of equals, the merger will bring together two companies which were founded in 1892 and are generally of the same size. The new corporation will have approximately 36,000 employees, 43 plants in 24 states in this country, and 16 plants in foreign countries.

Olin Mathieson products will include industrial and agricultural chemicals, petro-chemicals, "Squibb" pharmaceuticals, "Winchester" sporting firearms, "Western" and "Winchester" sporting ammunition, cellophane, polyethylene film, industrial explosives, non-ferrous alloys and fabricated metal parts, "Ecusta" fine specialty papers, "Frost" forest products, "Powell" insecticides, "Ramset" power-actuated tools and fasteners, and electrical products.

Present plans for the new company do not contemplate any changes in basic operations, according to Mr. Olin and Mr. Nichols. Principal offices will continue to be maintained in East Alton, Ill.; Baltimore, Md.; New Haven, Conn.; and New York, N. Y.

Mathieson Chemical operates two DC-3's and a *Twin Navion* for business transportation, and Olin Industries operates three DC-3's and a Twin Beech.

## Check Flight Info Manual For Unlisted Weather Numbers

To expedite obtaining weather forecasts be sure and check the new CAA Flight Information Manual, Part One. Most of the unlisted Weather Bureau telephone numbers are shown for the various stations and data may be obtained on a 24-hour basis.

Whenever you land at an airport, should the F.I.M. not carry the unlisted number, the Weather Bureau representative will gladly give it to you if one is available for that station.

It has been suggested by the Weather Bureau that telephone requests for weather be kept as brief as possible so that the lines will not be tied-up too long. This will allow others to receive the forecasts with minimum delay.

In cases where a business aircraft operator has a number of pilots, much time could be saved by having one pilot obtain the weather forecasts for the group and post it on a bulletin board. It has been reported by the Weather Bureau that several organizations have tied up the only telephone over long periods, since a half dozen or more calls originated from the same company requesting weather information.

Please think about other pilots who may be waiting for the Weather Bureau line. No doubt you have been in a similar spot, when you were anxious to leave and the phone remained busy.

## NBAA Member Developes New Compass System

Pilots soon will know, better than ever, where they are headed.

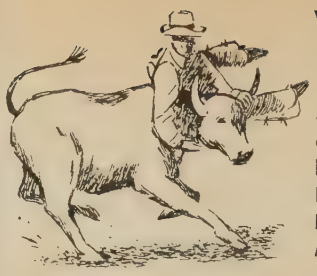
This is made possible by a new compass system—said to be three to four times more accurate than previous navigational systems—developed by engineers of the Meter and Instrument Department of NBAA-member, General Electric Co.

Offering a free gyro drift rate of less than 4° per hour, compared to the old standard drift rate of 12° to 18°, the device is expected to add materially to the success of long-range flights.

Secret of the compass system's accuracy is a radically new gyro motor design with sufficient operating force to meet the requirements for a low drift rate, yet offering simple construction, small size, and low weight.

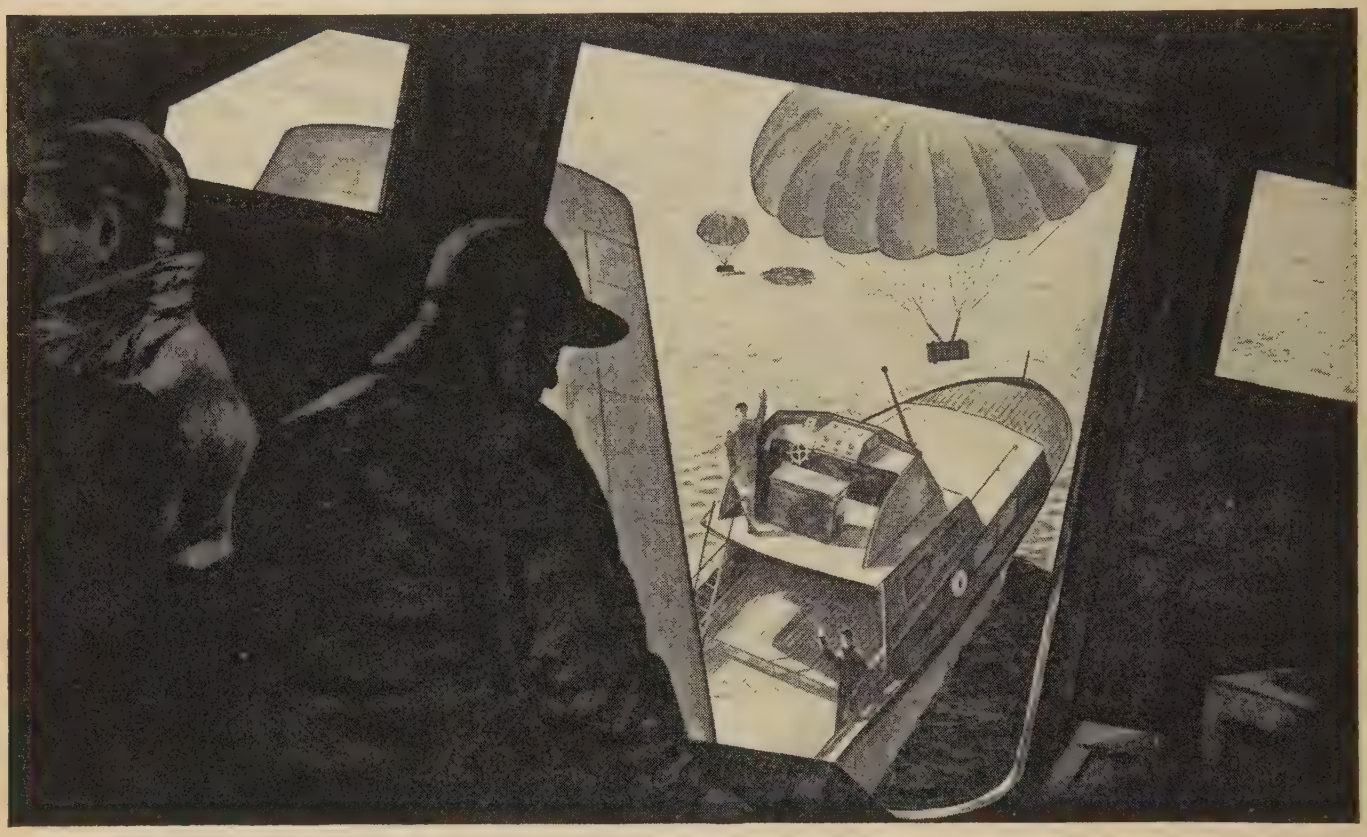
Navigational accuracy, GE reports, will be greatly increased by the use of the new system.

# PLANE FAX



## Your Best Week-end Flight Plan for September

Fly to a week-end of riding, roping, and Old West celebration at one of the biggest Western rodeos, the Pendleton Round-Up, September 16 to 18. Land at the Pendleton, Oregon, Municipal Airport for quality Standard Aviation products and service.



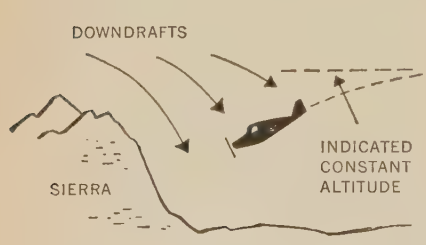
# Flying a rescue mission 260 miles at sea

**Flying food to stranded fishermen!** That was Jack Dowdle's job when a sport fishing boat was delayed by a storm and ran out of food and water at Guadalupe Island, 260 miles from San Diego. Just three hours after they radioed the Coast Guard for help, he was circling the boat, delivering supplies.

"Flying over open sea calls for top engine performance," says Jack Dowdle, whose Swift Air Service is based at San Diego's Lindbergh Field. "We always get dependable, full power with Chevron Aviation Gasoline 80/87. It gives us extra power when we need it, and ended the trouble we used to have with spark plug fouling in our Cessna T-50's.

"We've solved the problem of excessive engine wear, too, with RPM Aviation Oil. One engine has 1400 hours on it, with no valve or ring trouble! 'RPM' keeps our engines clean, and it ends pre-ignition and rough running."

You, too, can get improved performance and longer engine life for your plane with quality Standard Aviation products. No need to carry extra cash, either, if you use a Chevron National Credit Card, honored by Standard Airport Dealers everywhere for fuel, lubrication, and overnight tie-down.




## TIP OF THE MONTH

When flying on the lee side of a mountain crest or ridge, remember that downdrafts will make your altimeter read "high". It's possible to be in a steady descent and still get "constant altitude" readings.

T.M.'S "RPM," "CHEVRON," REG. U.S. PAT. OFF.

CHEVRON AVIATION GASOLINE
RPM AVIATION OIL
STANDARD OIL COMPANY OF CALIFORNIA

## Seattle Departure Routings Described in Seattle ARC Operations Letter

In a recent Operations Letter released by the Seattle Air Route Center, Departure Procedures were reported for not only Seattle but also Spokane, Bellingham, Boise, Ida., Portland, Ore., and others in the Seattle Control Area. The cut illustrates the climbing patterns, tracks and quadrants specified in the procedures for the Seattle metropolitan area which includes Boeing Field, Seattle-Tacoma Int'nl Airport, Renton and Seattle NAS.

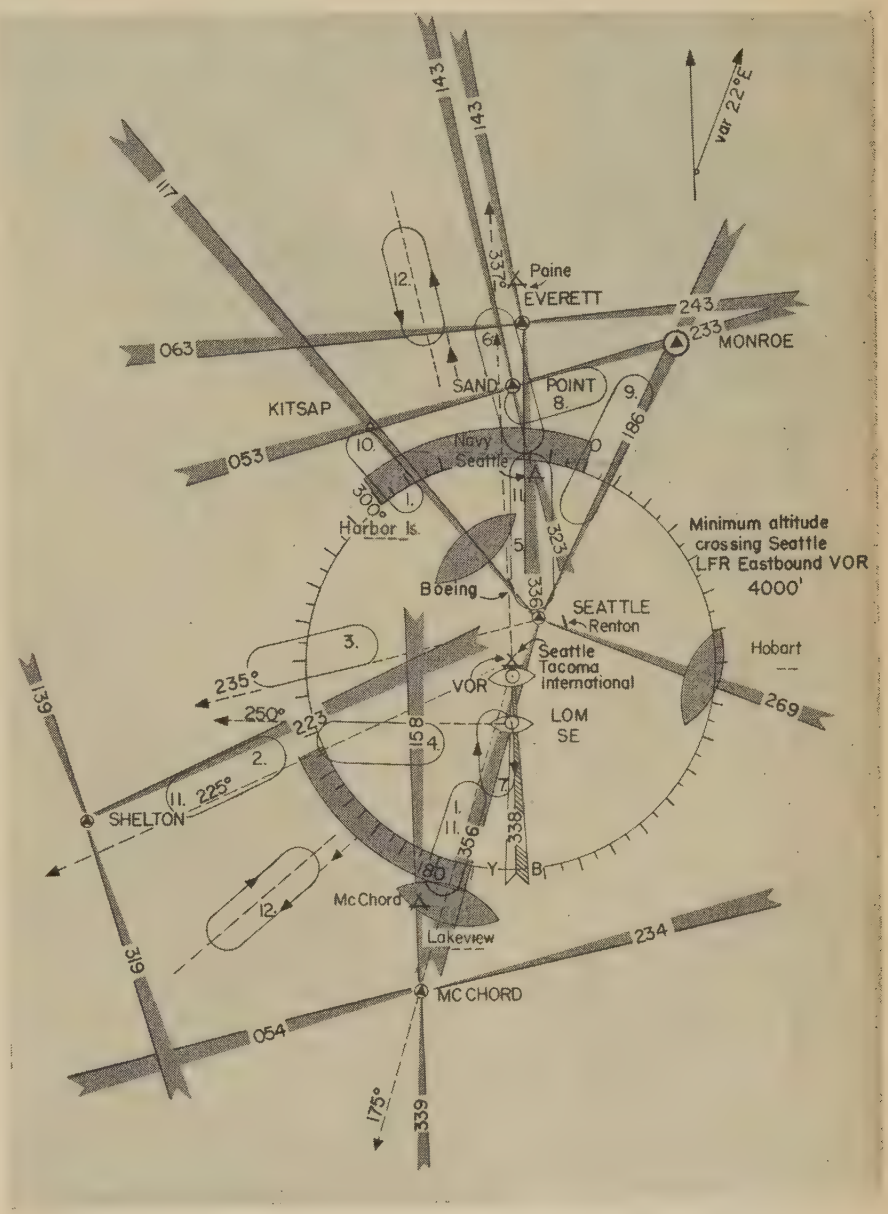
Departure procedures will be specified in the clearance only when traffic so requires. However, a flight will not be cleared "TO CLIMB ON COURSE" where a crossing altitude is indicated in the Letter. Crossing altitudes are minimum terrain clearance altitudes and shall apply to both enroute and departing aircraft unless a different altitude is published for enroute aircraft.

Pilot-requested departure procedures other than those prescribed may be approved, noting in the clearance that it is not a prescribed procedure and if, in the judgment of the controller, it is a hazardous procedure, a flight advisory to that effect will be issued in the clearance.

All crossing altitudes are predicated on the aircraft being able to make an unrestricted climb to the Minimum Enroute Altitude after passing a fix (a minimum climb standard of 500 feet in four miles up to 6,000 feet, and 300 feet in five miles above 6,000 feet is assumed for take-offs started below 4,000 feet). Where take-off is made at an airport of elevation above 4,000 feet, the first criteria (500'-4) is used to 8,000 feet.

A flight climbing in VFR conditions may either make such climb so as to cross the specified fix at or above the specified altitude. If unable, further climb must be conducted in VFR conditions to the Minimum Enroute Altitude for the route being flown. A crossing altitude of at least Five/On Top may be approved if known conditions indicate climb from Five/On Top to the MEA can be completed VFR.

In fog or stratus conditions, flights may be cleared to climb in the direction of take-off until On Top, provided terrain permits such a climb, and again climb thereafter to the MEA or crossing altitude must be made VFR.




Although the local Seattle procedures are outlined below, the procedures for all locations in the Center's area may be obtained from the office of the Chief Controller, James L. Whitmore at Seattle.

AIRPORT: Seattle-Tacoma, Boeing, Renton, Seattle, NAS

| *DEPARTURE* | *ALT. over SEATTLE LFR* |
|---|---|
| Southbound | Climb on course |
| Northbound | Climb on course |
| Northwest-bound | Climb on course |
| Southwest-bound | Climb on course (NE course Shelton LF Range) |
| Eastbound | Climb to cross range eastbound at 4,000 |

*Basic Departure Procedures;*

1. Climb on south course or northwest course of SEA LFR within 25 miles of station to assigned altitude.
2. Climb on northeast course of the Shelton LFR to assigned altitude.
3. Climb on an outbound *track* of 235° magnetic from SEA LFR within 25 miles of the station to assigned altitude.
4. Climb on a *track* of 250° outbound from the Seattle-Tacoma ILS

LOM within 25 miles to assigned altitude.

5. Climb on the south course of the Everett LFR between the stations and the Seattle LFR.

6. Climb on the north *and* south courses of the Sand Point Navy LFR between the station and points 10 miles north and south.

*Special Departure Procedures*:

7. Make shuttle climb in race track pattern between the Seattle-Tacoma ILS LOM and a point *two minutes south,* all turns right, to assigned altitude, then continue on course.

8. Shuttle climb on east course of Sand Point Navy LFR between the station and the Monroe Radiobeacon to assigned altitude.

9. Make basic climb to minimum of 2,000 feet, then climb on the northeast course of the SEA LFR between the station and the Monroe Radiobeacon, all turns *to the West.*

10. Shuttle climb in left turn race track pattern between the Kitsap Intersection and a point *two minutes southeast* to assigned altitude.

| *DEPARTURE* | *ALT. over SEATTLE LF* |
|---|---|
| Northbound - Victor 23 | Climb on course |
| Eastbound - Victor 2, V 4 | Cross VOR range eastbound at 4,000 |
| Southbound - V 23 | Climb on course |
| Southwest bound - V 27 | Climb on course |

*Basic Departure Procedures*:

11. Climb on the 175°, 225° or 337° *radials* of the SEA VOR within 25 miles of the station to assigned altitude.

*Special Departure Procedure*:

12. Climb on any radial of the SEA VOR *from* 175° *clockwise through* 225° and *from* 300° *clockwise through* 360° within 25 miles of the statin to assigned altitude.

## Air-Aids Spotlight

ALEXANDRIA, La.—*Swinging the NW leg of this LF Range to 113° inbound plus the clockwise shift of the Shreveport LFR S course provides the needed detour of Red 30 around the Barksdale AFB traffic.*

AQUADILLA, Puerto Rico—*For info of island hopping pilots, the Ramey LFR on 391 kc now bears 78°, 168°, 258° and 348° inbound.*

ASHVILLE, N. C.—*Early commissioning of VOR seen if tests on 115.1 okay.*

CORBIN, Ky.—*VOR tests on 116.9 mc indicate early replacement of the VAR on this North-South airway.*

FT. MYERS, Fla.—*LF Range on 341 kc swung clockwise as follows—43°, 170°, 220°, SE leg unchanged.*

GOODLAND, Kan.—*The loss of the LF radio beacon on 353 kc marks the end of the last remains of the LF Kansas City-Denver airway. Direct now means VHF or else.*

JOHNSTON, Pa.—*VOR due on 113.0 mc is the first bite on the 160-mile gap on Victor 12 between Harrisburg and Pittsburgh.*

LUMBERTON, N. C.—*Decommissioning of the VOR at this location is like losing an old friend on this popular North-South airway.*

MASSENA, N. Y.—*LF voice facility changed to 317 kc.*

MADISON, Wis.—*Tower LF voice now on 278 kc.*

PAYSON, Ariz.—*Radio beacon on 248 kc decommissioned.*

RIVERSIDE, Cal.—*USAF VOR on 113.4 mc keys "RIV".*

ROCKLAND, Me.—*Thanks to Northeast Airlines, radio beacon on 353 kc available for public use, 4 miles 33° to airport "RKD" now. With Bar Harbor beacon on 320 kc, "BHB", Blue Airway 84 now extends controlled airspace from Bangor to Augusta.*

SAVANNAH, Ga.—*Position checking on Amber 7 or Blue 39 via SAV ILS above 5,000 msl unreliable due interference from Augusta ILS on same frequency.*

WHITE SULPHUR SPRINGS, W. Va.—*Private radio beacon on 406 kc, keying "SSU available to pilots seeking this resort strip.*

WICHITA, Kan.—*VOR removed to new location 8 miles west of city now on 113.8 mc.*

*CAUTION! THERE IS NO SUBSTITUTE FOR aural identification! Particularly now that removal of the identification from any radio aid is warning that same is out for maintenance despite receipt of signal!*

*NOTE the new step to eliminate pilot necessity to refer to non-standard holding charts by having ATC describe the desired non-standard pattern in the clearance. Terminal area charts still include holding patterns.*

## ILS and GCA Endangered by Diathermy Machines

Too little publicity has been given to one of the least known hazards to air navigation, namely, illegal diathermy machines used in hospitals, physicians' offices and homes.

These devices, which were first developed before 1947, were at that time assigned frequencies by the FCC as part of the over-all allocation of VHF frequency channels to public, military and industry. In theory, owners of existing machines, conversion of which was found to be too expensive, were given until June 30, 1953 to realize on their investment, and replace with post-1947 equipment.

On this basis, the assignment of VHF channels for ILS, GCA, Police and other uses was made operational after that date. The startling fact is that, in many instances, despite the threat of severe civil penalties, such as $10,000 fine and up to two years of imprisonment, this policy has not been too vigorously enforced. It is estimated that at least 35% of all diathermy machines now in operation are **illegal!**

The result is that, due to spurious signals emanating from these pseudo "radio" transmitters, airborne reception of ILS Localizer and Glide Path signals can be seriously effected. Aside from the annoyance of a discontinued approach on instruments, there is no assurance that a proper flag warning would result.

Any bending or deflection of the ILS signals received at the airplane receiver would not be caught by the voltage monitoring system at the ground transmitter. Frequent reports of such deflection are common by pilots flying these systems in VFR weather for proficiency proposes.

Unless caught by the accurate measuring devices of the CAA Airways Flight Inspection Patrol pilots on all too infrequent check flights, the existence of such critical interference rarely is traced successfully.

Another adverse effect of these somewhat popular pain-soothing devices is on radar screens, which are increasingly relied on today for not just GCA approaches, but for faster and more efficient air traffic control in high-density areas. When something interferes with the operation of these radars, air traffic control agencies employing them have to revert instantly to older, slower procedures. The hectic transition period thus resulting is fraught with danger, while aircraft with less than standard non-radar separation must suddenly be afforded

this extra safety margin.

In the high-density areas such as Chicago and New York, the existence of more than one radar unit, when a condition of interference cripples one or more scopes, frequently has resulted in an exchange of mutual accusations between the towers effected and the accompanying indignant denials. It now appears that all parties may have been innocent and some local housewife easing her arthritis with a rented home diathermy machine is the guilty culprit.

Interference by these machines is not necessarily limited to local areas only. FCC monitor stations across the country have ADF'ed on offending machines over a thousand miles away. The FCC advises that, because of spurious radiations, interference can be caused on navigational frequencies far removed from the one on which the diathermy equipment is being operated. In later improved machines spurious and harmonic radiations can be suppressed while the fundamental frequency selected for therapeutic purposes can be confined to allocated bands.

Therefore, the FCC points out, the public—and especially the flying public—can best help itself remove this menacing condition by calling the foregoing to the attention of all known operators of such equipment, whether doctors, rental agencies or hospital staffs. In cases where a machine is suspected to be a pre-1947 machine and the operator appears indifferent to his legal responsibility, it would appear to be the patriotic duty of a citizen to call the matter to the attention of the FCC and other law enforcement agencies, as you would the operator of any other device detrimental to public safety.

A sort of sardonic justice exists in the equally interesting fact that these illegally transmitting machines are quite capable of "capturing" the undivided attention of the latest arm of national defense, the radio-controlled homing guided missiles, should one be launched for training purposes from the many bases being set up around our domestic approaches. Safety provisions to explode such an errant missile in mid-air might fail if the hapless illegal "homer" machine were unexpectedly close to such a launching site!

Last but not least, inasmuch as these diathermy machines are perfect radio beacons in such instances, they could not only serve to mis-guide legitimate air traffic, but in the event of an enemy attack, they could nullify the anti-homing program of CONELRAD, the Civil-Military defense plan set up to prevent giving enemy aircraft easy radio-homing guidance.

Aside from airborne detection of such interference, every pilot and other person associated with the industry can help by reporting any persistent or frequent interference observed on his home or car radio, or television. Pilots, as trained observers, are outstandingly qualified to make observations most useful to FCC in tracing this hazardous condition.

## Los Angeles Radar Departure Revisions

For the information of pilots operating IFR out of Los Angeles, there have been a few changes in the Departure procedures. The principal changes are in "short" clearances issued in conjunction with Radar Departure Control. For flight planning purposes, depending on the route the pilot wishes to fly, he may be expected to be cleared to:

MALIBU Intersection
PALOS VERDES Intersection
FERMIN Intersection
CATALINA Intersection
SAN PEDRO Intersection

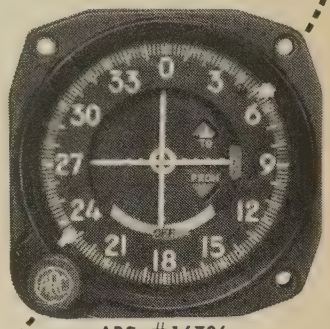
(This eliminates OCEANSIDE and CANOGA PARK Radiobeacons, the LONG BEACH LF Range and VOR, the LOS ANGELES LF Range and the LA HABRA Intersection as clearance limits for awhile at least.)

Under Stratus cloud conditions, with a known top, a pilot might receive a "short" clearance to all of the above fixes except the OCEANSIDE, CANOGA PARK and LA HABRA fixes, plus the BURBANK LF Range and the VICENTE Intersection.

IFR clearance limits under VFR conditions would be the same as for Stratus conditions. In the event of radio failure, the pilot would be expected to continue to the clearance limit as heretofore at the altitude assigned on departure; but then to *maintain that altitude in the holding pattern for five minutes, thereafter climb should be made in the same holding pattern to the cruising altitude specified in the pilot's flight plan.* Upon reaching cruising altitude, the pilot may proceed *direct* to the airway route filed in his flight plan, unless he has previously received and acknowledged for "an expected further routing" other than as filed.

This differs from previous radio failure procedures wherein the pilot was expected to proceed from the "short" clearance fix, *viz* his planned route or subsequently acknowledged ATC-amended routing, climbing from the last assigned altitude only as he was forced to adhere to the minimum enroute altitude, without regard for his original flight plan considerations.


new ARC course indicator puts two instruments in ONE!

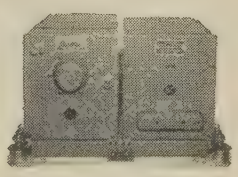


ARC #16706

Now users of the light, compact A R C Type 15D navigational receiving equipment can employ a single panel instrument that performs the work of two units previously used. The cross-pointer meter and the course selector have been combined into one part that fits a standard 3⅛" instrument hole. This saving in instrument panel space is important, particularly now that dual VOR installations are so popular. In addition to the space saving, installation costs are cut. Ask your dealer to specify the new #16706 Course Indicator as part of your 15D Installation—whether single or dual. The indicator may be purchased separately for use with older Type C and D equipment. Write for complete data.

Aircraft Radio Corporation
BOONTON • NEW JERSEY

TYPE 15D EQUIPMENT
For Airborne Reception of
• Omni-Directional Ranges
• Visual-Aural Ranges • Runway Localizers • GCA Voice
• Simultaneous Voice



R-13B Receiver with D-10A Dynamotor
B-13 Converter, E-14 Rack and M-10 Mounting

C-22A
Control Unit,
M-18 Mounting

A-13B Antenna

## Skyways Round Table

(*Continued from page 20*)

"We also have a helicopter as part of our fleet and we vary our inspections somewhat on that machine in that we run our checks every 10 hours . . . 10, 20, 30, etc. We have found that we can't get away with operating the helicopter without inspecting it more frequently than the conventional type of aircraft.

"We have a very formal inspection department and we have three full-time inspectors to follow up on the mechanics' work. We also employ the crew chief system. Every airplane has a crew chief assigned to it. We even have a crew chief assigned to the *Navion* we operate. When any airplane goes out of town, the crew chief goes along with it.

"I think we have just about the most experienced mechanical personnel you can find in the operations field, and we have had no labor turnover at all. Most of our people have been with us for five years and quite a few for over 10. Despite that, we feel that after a person has been working on a thing for a certain length of time, he is apt to become a little complacent about things. Therefore, we do use formal inspection procedures and we find it necessary to have the crew chief accompany the airplane at all times since he is the one who is responsible for the maintenance on that airplane. Also, we've found that we can get first-hand knowledge of what the mechanical or electrical trouble is on an airplane from the mechanic."

**Mel Rummel:** "*We should hear from the fixed-base operators and see what their approach is to the problem of aircraft maintenance procedures.*"

**Charles Weite** (*Service Mgr., Atlantic Aviation*): "We've been in business as the Beechcraft distributor at Teterboro for seven years, and have been able to do a good job because we've had a factory source of supply behind us. However, the hangar that I'm in is fairly new to us and 95% of the aircraft we handle are business planes in the DC-3 or *Lodestar* class. All of our maintenance is done on a progressive basis, but I'm running into a problem in trying to set up our stock room so that we can give the customer better service. I have tried to get the pilots to go over their past records and give me clues as to what they are or may be in the market for, but I haven't had much luck. For some reason or other they are reluctant to divulge that information. We would like to stock a particular type of accessory to fit their aircraft so that, when necessary, we could make a fast switch for them, but we're not getting the cooperation from the crews that would enable us to do that.

"There are nine heavy aircraft A&E's on our payroll with anywhere from nine to 15 years experience, so we are qualified to handle just about everything. But the business pilots are not helping me to help them by having their needed items in stock. The pilots come to me when they need something and expect me to do wonders without their giving me cooperation in advance of their needs. If the pilots would work more closely with the fixed-base operator, we could do a better job for them.

"As far as 100-hour inspections are concerned, we have our own forms. I have worked up a form that applies to all aircraft and it comprises about 10 pages. We use that in conducting our 100-hour inspections. However, in the past year and a half we have never tied up an airplane for a 100-hour except when its annual was due. On the heavy aircraft, it is done on a piecemeal basis, but on a small plane such as a *Navion*, it is done in one day."

**Mel Rummel:** "*That seems to bear out what Bill Person said about this interchange of information from a maintenance standpoint.*"

**Charles Weite:** "There are a certain number of corporations based with us who have their own ground men, but when a job gets a little too heavy for them, they rent labor from us. With other corporations we do the job strictly on our own. We have found that a good many of the crews will go out and spend their time and money on phone calls trying to trace down a certain unit for their aircraft. Then, when they have run out of ideas of where to get the unit, they'll come to me. Actually, it's usually just a matter of my picking up the phone and putting my finger right on the unit they want. With that in mind, we've tried to prove to those fellows that in most cases we can handle a unit through our Parts Department for either the same cost as they could get it or even cheaper. That's what we are trying to sell to corporation pilots—that we have better leads and can save them a lot of leg work if they'll send their business through our Parts Department."

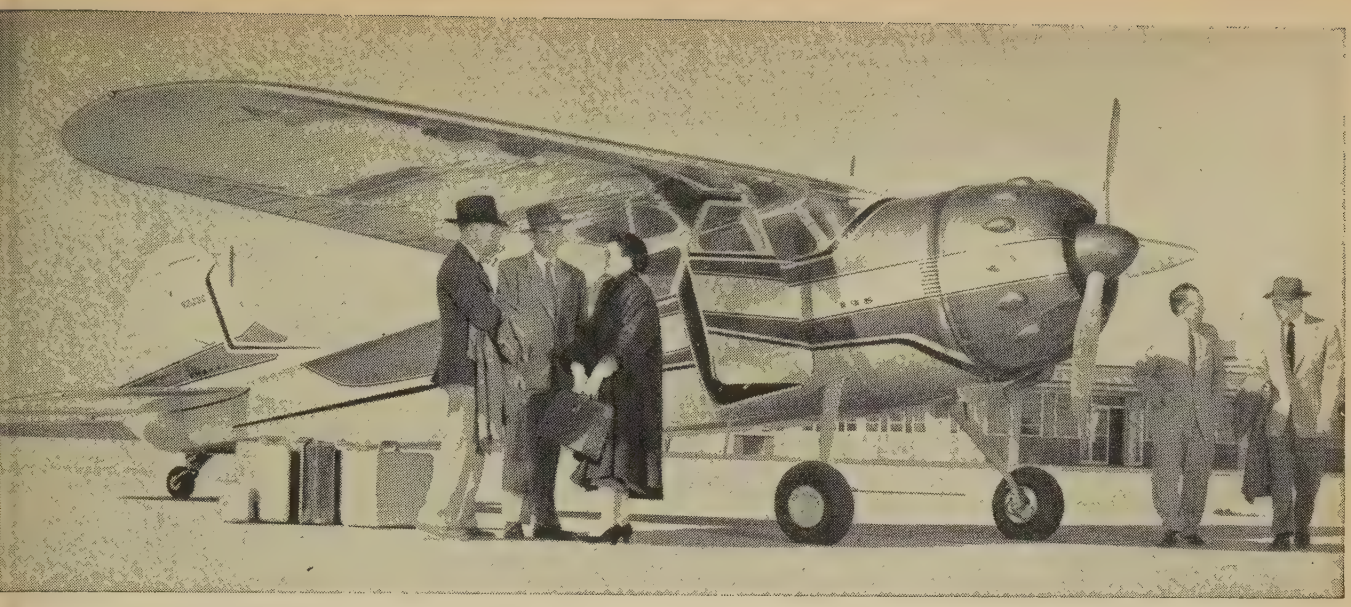
**A. M. Bertolet:** "Progressive and equalized maintenance are laudable terms and have an application with those operators, *i.e.* the airlines, who can evolve systems based on known scheduling, known utilization by the month, etc. Even large business-aircraft fleet operators can do advanced planning, but most single business-plane operators don't know what their monthly utilization is going to be. It's non-scheduled to begin with, and to try to put non-scheduled operation on a scheduled maintenance plan is difficult.

"I feel that a 100-hour inspection is a form of progressive maintenance, and I also think that at one point or another the airplane should be taken out of service and inspected thoroughly by disinterested people who do not live with the airplane every day. Mr. Brown from Sperry indicated they have a formal inspection staff; they do not take the pilot's or a crew chief's word. I think that is very important and necessary with regard to any airplane.

"I think we need to have fixed points of time at which the airplane is inspected, whether it's a 50-hour, 100-hour or what-have-you. At Reading our approach has been on the basis of a corporate-aircraft utilization of 500 hours a year. We have a planning board that indicates we accomplished an inspection on the 15th of May, for example, and based on average utilization, another inspection is due in about 2½ months. Two months from the last inspection we get in touch with the Chief Pilot and ask if he's coming up for another check. Sometimes he comes in, and other times he reports he's been running slow and won't be in for another 10 days or so, so you erase him from the schedule and mark him down for the later time. It takes anywhere from 50 to 80 man-hours to run an inspection on a D-18 Beech, so we put enough men on the plane when it does come in to get the inspection accomplished in one day. We don't think that doing some inspection one day, then having the plane go out and come back some other day for further inspection is satisfactory. I don't believe the aircraft really gets a thorough and complete inspection that way. We believe the most important element in the maintenance business is advance planning to maintain operational utilization, whether it's at 30, 50, 100 or 120 hours. The airplane must be fully and completely inspected and signed off by men who haven't anything to do with flight operations.

"With respect to the standard CAA forms, manufacturers' forms, etc., we have found it desirable to enlarge and add detailed items in areas where known weaknesses on various types of aircraft have developed. Ad-

(*Continued on page 32*)



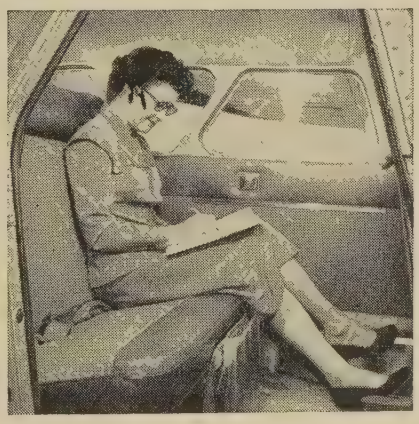
# *5-Place Utility–Single-Engine Thrift!*

**New Cessna 195 Offers Greatest Room, Luxury in Single-Engine Field . . . 12 All-New Features!**

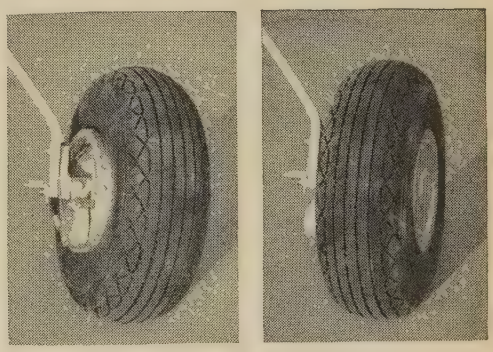
Fly it! Compare it! The one *and only* airplane that offers *both* 5-passenger convenience and single-engine economy—brilliant new Cessna 195! It's powerful! Cruises over 165 m.p.h.! Offers greater comfort than any other single-engine ship! Twelve new features including 50% increase in flap area, larger tail surfaces for easier control, smoother flight, new interior color combinations. For information, see nearest Cessna dealer (listed in yellow pages of phone book) or write CESSNA AIRCRAFT CO., DEPT. S-9, WICHITA, KAN.

## Cradled Comfort

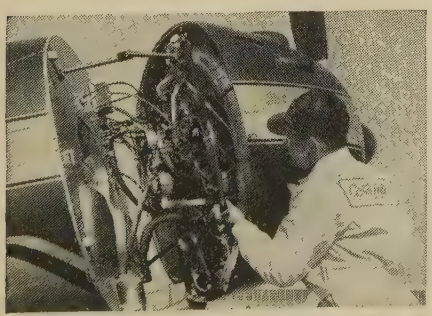
Relax in extra-soft foam rubber seats . . . stretch your legs out *full length* . . . enjoy complete comfort! Four fresh-air ventilators; a large thermostatically controlled heating system; entire cabin area is soundproofed. And for a smoother ride, you sit beneath the wing, out of the sun, with a "control tower" view of the scenery below.



Cessna
AIRCRAFT COMPANY



## Hinged Engine Saves Hours



Remove 2 bolts and the Cessna 195 engine swings out for immediate maintenance! You have a choice of two engines: a 300 H.P. Jacobs or a 275 H.P. Jacobs. Both powerful, economical, service-proved, and equipped with Dynafocal shock absorbers for smoother performance.

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**4 GREAT CESSNAS 170 180 195 310 THE COMPLETE AIR FLEET FOR EVERY BUSINESS NEED**

## Skyways Round Table

(*Continued from page 30*)

ditionally, it has been our experience that while standard inspection forms in common use generally cover all major items to be inspected, they do not list the items in the most orderly and efficient sequence. As a result, we have spent considerable effort to apply time and motion studies in an attempt to minimize back tracking, etc., on the part of the inspection crews.

"In summary, I'd say that progressive maintenance is applicable to those operators who have some definite form of flight scheduling . . . and that is very limited in the field of industrial flying. Secondly, I think that whether we call it progressive or equalized maintenance, some form of it is taking place even on the usual 50- or 100-hour inspections. Thirdly, I feel that the maintenance standards accepted in the business-aircraft field are higher than those of the airlines. And finally, I believe that some effort should be made to schedule maintenance and that the airplane commander can be helpful in this respect. If that could be done, I believe it would improve operations, both from a utilization and quality standpoint."

**Robert S. Northington** *(Vice Pres., Piedmont Aviation, Inc.)*: "Preventive maintenance is something we have been trying to sell our customers for a long time, and some of them have gone along with it.

"As Charlie Weite brought out earlier, there is the problem of parts availability. We try to have a good stock of parts because we realize that the airplane must not be tied up any longer than is absolutely necessary. Our large stock of parts is based on the normal flow of maintenance business that we receive from our customers. Fortunately, some of our customers let us know three or four weeks in advance of when they plan to be in. That's a great help to us, especially on 1,000-hour checks.

"Another thing we do is to furnish additional labor to those corporations who are based in Winston-Salem and who have their own copilot-mechanics. The company mechanic runs the progressive inspections and the only time they have someone else look at the airplane is on annual inspection.

"As far as the inspection forms are concerned, we use the basic CAA forms, although we add additional items we feel are advisable.

"Also, knowing insofar as possible the type of accessories, engines, radios, etc., that our customers use enables us to have available on an exchange basis practically every item necessary. We keep in stock items on accessories and engines up to and including the 1830-92's. We are also endeavoring to give a flat rate on labor for all types of inspection and overhaul of accessories, carburetors, etc. Customers like to know about what it's going to cost for an inspection. That, however, does not include any work that may have to be done after the inspection is made.

"Piedmont is endeavoring to offer its customers as much of a one-stop service as possible, so that the customer won't have to tie his airplane up two or three different times at different places. We have, therefore, gone into very comprehensive radio, maintenance, overhaul and service on engines, conversions and modifications, trying to cover as best we can the entire services for planes up to and including the DC-3. We are also now in the process of writing a maintenance manual for the DC-3 to increase the gross load."

**Mel Rummel:** *"Do you have organzations that come in with their own inspection forms . . . . or do they just come in and sign up for a* 100-*hour check?"*

**R. S. Northington:** "Some of our customers have their own forms. However, as I said before, the companies that have their own mechanics do their own maintenance, except in those cases where extra help is necessary because of the time element. Most of the time we furnish all the parts they need."

**Mel Rummel:** *"Bob, do you think there is need for an interchange of maintenance information so that you'd have an idea of what to look for or expect when running a check?"*

**R. S. Northington:** "Information of that type would be very helpful. In our case, when we find something on a particular airplane that is causing trouble, we look for that same trouble in other airplanes of that same make. Just recently, we had a couple of serious cases of breakage of airplane parts, but I'll bet people on the West Coast or in the Mid-West never heard of it and won't until they happen on similar cases themselves. Information of that type would be very useful and helpful."

**Mel Rummel:** *"George Moore, what are your thoughts on this problem of maintenance procedure?"*

**George W. Moore** *(Gen. Mgr., Butler Aviation)*: "We are primarily in the business as an aid to the executive operator, so we planned our entire operation on the basis of being able to do his maintenance when he requires it. As to progressive maintenance, we find that about 50% of those who come to us for checks do so on a progressive maintenance basis. The other 50% prefer to lay up their airplane over the three or four days necessary to complete the 100-hour check.

"Some of our permanent hangar tenants do their own maintenance. They have copilot-mechanics who run their own 100-hour checks during the year, and then ask us to run one while they stay completely away from the airplane.

"Another type of maintenance that we do is scheduled maintenance for those companies that are based elsewhere. In most cases these people give us sufficient advance notice so that when they come in we are ready for them and are able to complete the work with a minimum of delay.

"As far as stock is concerned, we maintain as high an inventory of spare parts as we think is feasible. As our maintenance increases, our stock increases. Of course, we always have on hand spare parts for the popular engines that are being used, but we don't try to stock parts for engines that are not as popular as far as the executive operation is concerned. These parts can be obtained within 12 hours, however.

"One other thing I'd like to mention is the warranty period on engines and accessories. We are now finalizing and will in the future offer a warranty carried to the point where we will replace an engine, should it fail at any point in the U. S., at no cost to the customer. The replacement also includes installation of the engine. We feel that executive flying depends a great deal on reliability, and we know that our engines will stand this kind of warranty."

**Leonard Lee:** "On the subject of interchange of information, those fixed-base operators that have a DAMI or are Certificated repair stations get a monthly bulletin that the CAA puts out on defective parts and defective operations. There seems to be a reluctance, however, on the part of many corporate operators to file a defect report with the CAA. We happen to be between the devil and the deep blue sea on this because we have our fixed-base operation and are looking for more information, and we also have the corporate operation that doesn't want to get any fixed-base operator or overhaul agency in bad by filing a report on an engine or an accessory. Therefore, the lack of information is astounding. The Piper *Cub* operator

(*Continued on page 34*)

# *Who pays half fare when they go by air ?*

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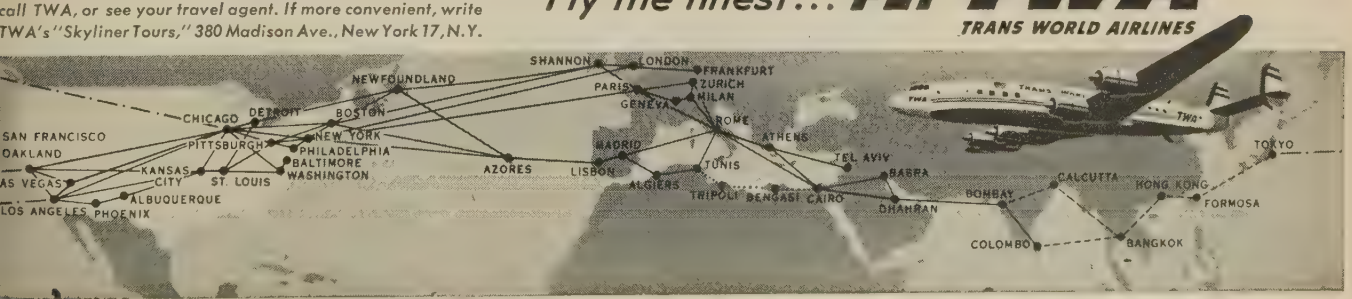

## Skyways Round Table

(*Continued from page 32*)

fills out a report right away, but you get nothing at all from the corporate operator or copilot-mechanic. If we could set up some sort of exchange of information with regard to defects, malfunctions, etc., perhaps through Flight Safety Foundation or Flight Safety, Inc., it would be a wonderful idea and very helpful. Of course, that comes home to us more now because we are operating the Martin B-26. There are only two outfits in the country operating them—Tennessee Gas and ourselves, so we cry on each others shoulders and there's a constant interchange of information. But as far as other aircraft are concerned, Lockheed, Beech, etc., we get practically nothing out of them. If a gear folds, it's not the airplane's fault, it's the pilot, as far as the manufacturer is concerned. We've heard of gear failures that I'm convinced were not pilot error, but were malfunctions of the airplane."

**A. M. Bertolet:** "This central intelligence agency idea is very desirable. However, the time element is important. How can we get the information on a collapsed gear, for example, before the next case like that happens? That would seem to be the problem."

**Charles Weite:** "I'd like to add to that. We had a case out at Teterboro about six months ago in which one of the postwar planes left our hangar, started down the taxi strip and fell on its nose. Of course, the plane was brought back to us and we replaced the props, the nosewheel assembly, etc. Two days ago, one of our regular tenants who has the same type of aircraft started down the taxi strip and the nosewheel didn't feel right. He turned back and asked us to check it. We immediately went to the spot we'd discovered from the first mishap and found that the assembly had broken. Now this fellow was willing to complain to the manufacturer about it, but he was reluctant to report it to the CAA. I finally persuaded him to do it. A postwar airplane is going to have bugs in it, and I think they should be brought out into the open. Instead, you get a transient in your hangar; he stays overnight; he leaves; and then something happens and he immediately accuses the fixed-base operator of damaging the nosewheel through improper use of a tow bar or something like that. Chances are a tow bar was never even put on the aircraft.

"Getting back to the parts situation, I don't feel that the manufacturer is giving us the service we should get. Our delivery date is much too long."

**R. S. Northington:** "I agree that a lot of our problem regarding the availability of parts lies with the manufacturer, but to a certain extent the trouble also lies in our own baliwick. It's hard, but we have to stay up with the lead times that are necessary. The availability of parts is a dual responsibility."

**Leonard Lee:** "Like everyone else in the executive-transport business, we have bought and used a lot of surplus parts on our aircraft. This surplus actually is expensive to buy and expensive to operate because of its rate of attrition. Therefore, when we started our Martin B-26 project, we decided that nothing surplus would go on that airplane; everything was to be brand new. At that same time, we also began a program of replacing everything surplus on our other aircraft with brand new parts from the manufacturer. The initial cost has been high, but in the 11 months since we started that replacement program our over-all operating costs on those accessories


*Model*

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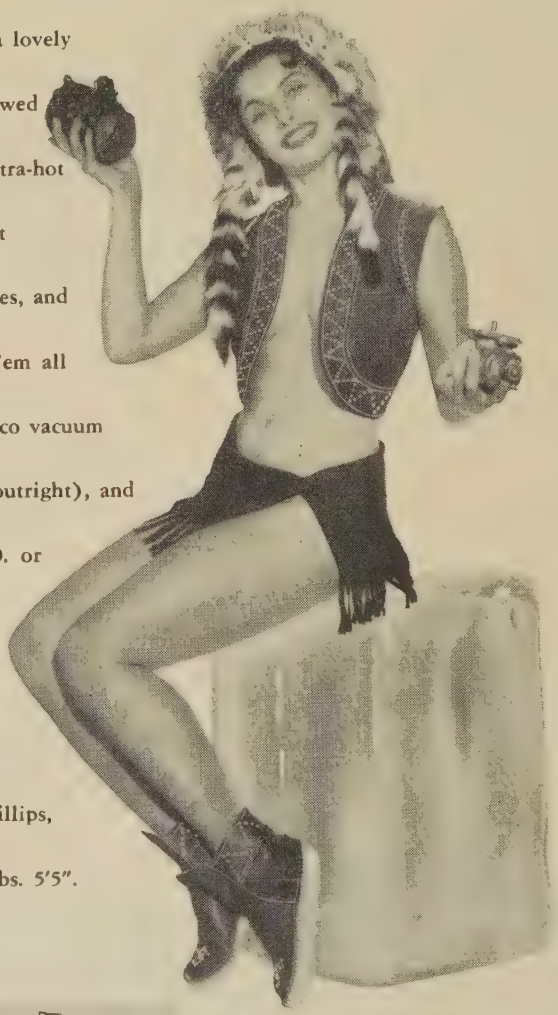
Accessories seen here include a lovely young lady, an Indian rig borrowed from the Dobbs House, two extra-hot items overhauled by Southwest Airmotive for exchange purposes, and a 100-lb. cake of ice to keep 'em all cool. Held aloft are a 207J Pesco vacuum pump ($65. exchange or $85. outright), and a 4100 Pesco Fuel Pump ($30. or $45.), both for R-985 engines. The Pocahontas-type accessory about which this summertime idyll is woven is Carmen Phillips, 18, black hair, blue eyes, 119 lbs. 5'5".



Southwest Airmotive COMPANY
LOVE FIELD DALLAS

and parts have been less than it was in using the surplus.

"The surplus market has gone up tremendously over the past two years. Not too long ago, we were quoted a price of $425 a set for high-pressure brakes for the *Lodestar*. We bought brand new brakes from the manufacturer for $465 for both wheels.

"As far as the fixed-base operator is concerned, until he gets his clients to start thinking in the direction of replacing surplus parts and equipment with newly manufactured items, it will be an ever-increasing problem to keep up with the parts market."

**George W. Moore:** "I agree with you 100%, but it is going to take a tremendous merchandising and sales program. Unfortunately, I think the feeling still exists that the surplus is cheapest. Many do not realize that it is cheaper in the long run to operate with entirely new parts. Believe me, as a fixed-base operator, we'd rather stock new parts."

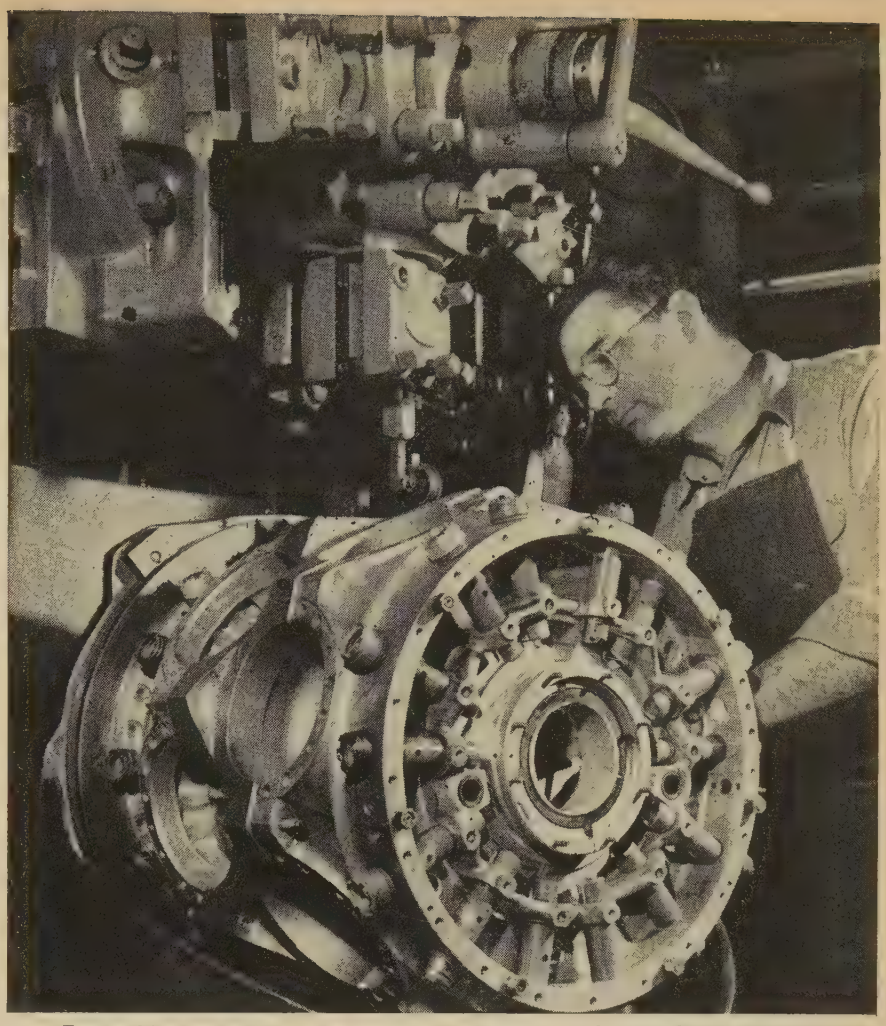
**R. S. Northington:** "We do not do a great deal of maintenance on corporation DC-3's, but we have tried to stock and sell the new parts and accessories for those we do handle. It takes time to standardize on accessories, engines, radios, etc., so that we can render a service to those operators by stocking the parts they need."

**Bill Person:** "After listening to this conversation, the thing that strikes me is that the big problem is to make everyone in the business-flying field aware of the fact that there *is* a problem. I wonder how many operators really know about this monthly report of mechanical difficulties? Perhaps an appeal should be made to everyone in the executive-aircraft field to take advantage of and utilize this information as well as to contribute to it. But first of all you have to show the pilot and the man in charge of maintenance that there *is* a problem, and get them to participate in it.

"It's like the collision problem. There is a lot of complacency about mid-air collisions for one reason only . . . . people just don't realize how serious it is. If they did, you can bet your boots they'd be looking all over the place all the time."

**Gerald D. Brown:** "I agree entirely on this matter of dissemination of information, and I also think that the CAA is doing as much as it can with the limited manpower and funds it has. Actually, what we need is greater dissemination of information between individuals operating all types of aircraft: *Cub* or *Con-*

(*Continued on page 36*)

Rematching a new center section to a crankcase, a highly specialized operation.

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## Skyways Round Table

(*Continued from page 35*)

*stellation.* Maintenance is everyone's concern. Perhaps part of the problem of getting the necessary information stems from the fact that corporation pilots are so busy making certain there aren't any delays to get the boss mad that they don't take the time to file reports. Some seemingly little thing happens and it's a nuisance, but after you've landed and the sun is shining, you forget all about it. I can cite an instance in that direction.

"A few weeks ago an airplane caught fire shortly after take-off from an airport on Long Island. The plane crashed and killed the passengers and pilot. Investigation pretty well established the fact that the fire occurred in the cockpit in the air. Well, we operate an airplane of the same make and so we were interested in finding out what happened. I remembered that about two months prior to this accident we had trouble with a seal in the electric fuel boost pump. There is an overflow drain on the righthand side of the ship from this pump, and it was dripping fuel on the ground. When we saw it, we immediately pulled the pump off and replaced the seal on it. It was just one of those things that happened and normally wouldn't have meant much to us. It certainly didn't warrant a defect report to the CAA. But when fire occurred in this other plane, we immediately called the CAA and reported our experience to them in the hope that it might help establish a pattern and something helpful could come from it."

**A. M. Bertolet:** "I think there is something else that is quite serious and it effects your shop and mine. All of us get aircraft we've never seen before, and the common reaction among maintenance personnel is to look at the work done at some other place and compare it with what they think should have been done. We'd rather not start back-biting, but in some instances we feel the aircraft operator should be advised of possible shortcomings. We all have good organizations, but . . . . the human element enters into it. An airplane comes in, we tear it apart and find a number of discrepancies from a quality standpoint. Yet nothing is ever said about it because we don't want to get another organization into trouble. I think it's important that higher standards of work be made to prevail."

**Mel Rummel:** "*Speaking of higher standards and in connection with this progressive maintenance idea, do you think it is possible to get the same type of maintenence at different bases? In other words, let's say you stopped at LaGuardia and had some item of maintenance accomplished, then went on to Reading for another, and to Piedmont for still another, do you think maintenance practices are such that you could get the same type of maintenance at each place?*"

**A. M. Bertolet:** "I don't believe that's possible. After all, the CAA establishes minimum, not maximum standards."

**Gerald D. Brown:** "I'd like to ask one question. When these different operators come in to have work done, how do you handle the airworthiness directives or service bulletins?"

**A. M. Bertolet:** "One thing you can do is, when the airplane comes in for inspection, go right on down the line and see what bulletins are applicable. Obviously, you must do the ones that are mandatory; for the other ones you simply suggest that they be done to keep the airplane current from a directive standpoint."

**Gerald D. Brown:** "Frankly, I don't see how you can sign off an airplane unless you do all the things that have to be done, as are reported by the directives or manufacturers' bulletins. These are part and parcel of either an intermediate or an annual inspection."

**A. M. Bertolet:** "Inspections are an operator's responsibility. There's no law that requires any 100-hour check; you can run it from one annual to the next. The owner pretty well controls the maintenance aspect. You can say you'd like to do certain things for him, but where the directives are recommendations and not mandatory, it's still up to the airplane operator. Certainly, you don't sign off the bulletin unless it has been accomplished."

**Bill Person:** "That brings up the whole philosophy of business flying. It has very little regulation, most of it is just common sense. And it's entirely up to you service operators to sell these aircraft operators on the importance of preventive maintenance. There's no law that says a man must have his radio serviced because he happens to be flying on instruments. It's entirely up to the individual. What you have to do is build up confidence so that when a pilot pulls into your operation and needs work done on some inoperative piece of equipment, he can call on you and feel confident you'll do the right job. It's the responsibility of the fixed-base operator to offer service of the caliber required by business pilots and to convince them that it is worthwhile, safer and cheaper."

**R. S. Northington:** "That's absolutely right. We owe it to our customers to do the best job we can of recommending, explaining, or whatever else is necessary, relative to these bulletins. I'm speaking now of the recommended bulletins or changes, not the mandatory ones. We are obligated to our customers and must do this."

**George W. Moore:** "Our obligation is two-fold; one is to give quality maintenance at a reasonable and fair price; the other is to stay close to these aircraft problems day in and day out so that we are in a position to keep our customers current on all bulletins and recommended changes, and thus help him maintain his operation in top condition."

**Leonard Lee:** "Frankly, there are too many fellows flying corporate aircraft today who have sold and are selling their jobs right down the river. They are trying to operate $x$ number of aircraft for $x$ number of dollars. The dollars are more important to them than the efficiency and even safety of their operation. These fellows certainly are not fulfilling their responsibilities to their corporations by trying to operate cheaply and hence haphazardly. They are still romancing aviation and, believe me, business flying went out of the romance stage a good many years ago. It's big business today. To show you how foolhardy some of this is, I know someone who recently bought two engines that had been in salt water for two years! The engines were dug up and put on an airplane because he could get them for $1,000 apiece."

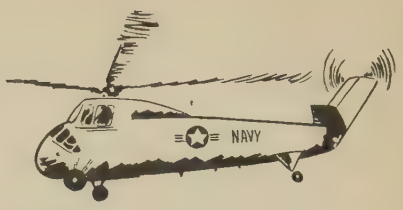
**A. M. Bertolet:** "In many instances an airplane is operated for a year's time with one man doing the maintenance. Then the airplane appears in a shop for an annual inspection or a 100-hour inspection, and the bill is a yard long. The owner says, 'Why this airplane has been perfectly maintained. I've watched over it like a mother hen.' Immediately, you are liable to criticism for recommending all these things be accomplished that the man thinks are unnecessary."

**Mel Rummel:** "*Along those lines, the NBAA has realized the problem and has set up a Flight Safety program. Bill Hall went to a meeting on it recently. Perhaps he can bring us up-to-date on it.*"

**W. R. Hall:** (*Mgr., Eastern Dept., U. S. Aviation Underwriters, Inc.*): "NBAA is sponsoring a Flight Safety Committee, and the purpose of the Committee is to come up with a so-called standard for safety which

(*Continued on page 38*)

# Why do most types of 'copters fly with Lycoming-built engines?



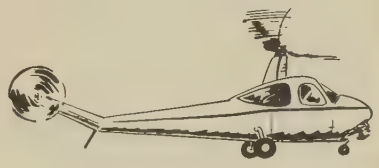

*Lycoming-powered* Sikorsky S-58*
*Anti-Submarine 'Copter*

*Lycoming-powered* Piasecki H-21*
*Matériel and Troop Transport*

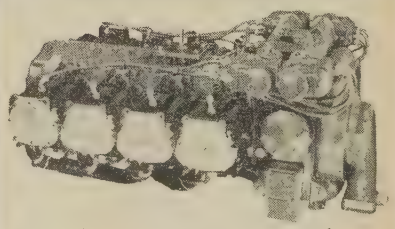
*Lycoming-powered Kaman HTK-1*
*Military Trainer*

*Lycoming-powered Doman L-Z5*
*General Utility 'Copter*

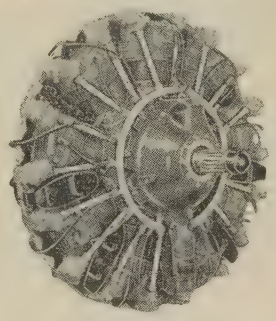
*Lycoming-powered Brantly Model B-2*
*Personal 2-place 'Copter*



*Lycoming-powered Glenview FlyRide*
*Personal 2-place 'Copter*



*4-, 6-, and 8-cylinder opposed air-cooled engines.*



*7- and 9-cylinder radial air-cooled engines.**

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*Wright-Cyclone engine built by Lycoming under license from Curtiss-Wright Corporation, Wright Aeronautical Division.

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## Skyways Round Table

(*Continued from page 36*)

might be acceptable to the NBAA membership. It is rather difficult to tell corporations owning aircraft how they should operate their planes, so the problem primarily has been one in which the Committee is trying to find a way of exposing the membership to the highest standards of safe operation.

"In this effort, the Committee has approved a questionnaire which is already in the mail to NBAA members. This questionnaire is set up in four categories: aircraft operated, company policy and operating procedures, flight operations, and aircraft maintenance. From the replies to this questionnaire we expect to set up a so-called standard for business flying."

**Mel Rummel:** *"At the beginning of this meeting, I stated that I didn't believe there had been any fatalities in the operation of executive aircraft due to mechanical failures, improper maintenance, or a combination of both. Do you think that is true?"*

**W. R. Hall:** "Generally speaking, the fatalities have been the result of poor weather conditions or inexperience on the part of the pilot. We have very little in our files to indicate that any of these accidents have been the direct result of malfunction. Such accidents are usually the result of a pilot sticking his nose into some bad weather and not being able to cope with it."

**Bill Person:** "Mel, there is a very important consideration which should be mentioned for the record which has not yet been discussed and that is how to save time and money on maintenance and yet improve the general safety of the operation.

"With proper and complete maintenance forms carried on the aircraft, 20 to 25% of the labor cost could be saved when trouble shooting, either by a fixed-base operator or a company's own maintenance department. In other words, with a good running record of maintenance for quick reference, the job of trouble shooting becomes simplified.

"Sime Bartolet of Reading Aviation and Bob Northington of Piedmont have stated that where an aircraft operator has the proper maintenance forms they are able to save him a considerable amount of labor cost due to the fact that they do not have to go back and hunt and discover maintenance work which has already been done at some previous time in attempting to find the cure for a given situation."

**Mel Rummel:** *"Gentlemen, allow me to express my gratitude for your valuable contributions of time, information and constructive thought. Before closing the meeting, I would like to summarize some of the points that I think we all agree on:*

1. *A definite maintenance program is essential to each operator, whether it be for one airplane or for a fleet of airplanes, for both safety and economic reasons.*

2. *This maintenance program must be tailored to the individual operator's requirements. The program can be set up on a flight time or calendar basis, progressive or equalized services, but always for better safety in operation.*

3. *Service forms and maintenance manuals containing specific checks and information on the individual aircraft would be a great help to fixed-base operators as well as the corporation doing their own maintenance. I believe the fixed-base operators stated that with this information available the man-hour costs on services could be reduced 20 to 25% in many instances.*

4. *There is a definite need for an interchange of maintenance experience, especially on mechanical difficulties. The machinery is available through the CAA, but requires the constant active support of the individual operators to make it effective.*

5. *The fixed-base operator has the continual problem of having parts available for the individual aircraft requirements. He should be provided with as much advance information as possible when these requirements are non-routine. Along the lines of this discussion on parts availability, serious consideration should be given to new parts vs. surplus parts. The fixed-base operator would rather stock new parts, replacements would be easier to procure and, in the long run, cost to the individual operator would be less due to better reliability and warranty replacements.*

*"Again, thank you, gentlemen, for participating in this discussion. The meeting is adjourned."*

## Reducing Costs . . .

(*Continued from page 13*)

for extensive charter operations.

Operational procedures for Aircraft Service follow this pattern:

Scheduling for the Russell Company is handled by R. H. Collom, assistant to the president, in coordination with his reservations personnel. Whenever a request for transportation is made to the reservations people, it is considered first for company aircraft. If it appears to be the sort of trip where aircraft can be used advantageously, the request is forwarded to Collom who checks schedules to determine whether an aircraft is available. He can coordinate the schedules of various departments to achieve a maximum load factor on most flights. As soon as a trip is scheduled, he calls the airport office and it is posted on the flight board. If it is a charter flight, the procedure is the same, with notification of the charter schedule going to the Russell Company.

Trips are scheduled on a priority basis, the first confirmed request going to the top of the list. Each airplane chartered is entirely at the disposal of the customer for the time of his trip and he can make any necessary changes in destination, departure times and stops.

Charges are based on a flight-mile rate for the entire distance the aircraft flies on any trip, including ferry distance if it is necessary to fly the airplane empty. For most flights, there is no charge for waiting time. However, since rates require a maximum of aircraft utilization, extended waiting times are not acceptable. When a delay is necesary for a relatively short trip, there is a maximum charge of $24 for a *Bonanza* and $40 for a twin-engine airplane. Flight-mile rate for a *Bonanza* is 20 cents a mile and waiting time is figured at $3 an hour. For a D-18, the rate is 50 cents a mile and waiting time is $5 an hour.

A flight log is made for each trip, one copy going to the flight office and the other to maintenance. The maintenance copy is then forwarded to a work order and filed on a clip board for action. Maintenance is done on a progressive basis to use ground time to maximum advantage. The entire operation is based on the CAA-approved operations and maintenance manual of the type used by the airlines.

Aircraft Service maintains a completely equipped radio department for sales and service. As a distributor for Lear products, AS was awarded a plaque a few months ago for outstanding sales achievement in the first year of its operation. The company's aircraft are equipped with Lear radio and autopilots and are used as demonstrators in the sale of these products. Aircraft Service also is dealer and sales representative for

Douglas DC-3 conversions.

From the beginning, the Russell Company realized that its basic problem—keeping costs in line while enjoying fleet utility and flexibility—existed in many other companies. During discussions before the purchase of Aircraft Service, it was estimated that a 30% higher utilization could be obtained if the Russell fleet were made available to other companies in its area on a charter basis.

Utilization has climbed steadily since Aircraft Service began operations as a unit of the Russell Company and the list of companies which charter aircraft from it also has increased. Seven companies, which have operated their own aircraft for years, supplement their flights by hiring Aircraft Service planes. They include the Weatherhead Company, Sundorph Aeronautical Corporation, Owens-Illinois Glass Company, Monongahela & Ohio Coal Company, Thompson Products, Industrial Sales & Engineering Company, Aero National Charter Service, and General Electric Company.

But far more gratifying is the fact that, as of the middle of April, the following companies, which do not own aircraft, were representative of the regular customers of Aircraft Service's charter service:

Emery Air Freight, Eclipse Counterbore Company, Standard Tool Company, David Davies, Inc., White Motor Company, Cleveland Press, Fulton Manufacturing Company, Roper Ordnance Company, Micro Machine & Tool Company, Spotweld Company, Dasher Chemical & Rubber Company, and Warner Swazey Co.

Each of these Aircraft Service customers is covered by industrial aid insurance during every charter flight. This type of coverage, through a "named insured" clause, gives each charter customer the same insurance (including admitted liability) that is applicable to the Russell Company. It is equivalent to the insurance carried by the largest companies operating their own aircraft.

The storage, maintenance and service facilities of Aircraft Service, as seen from the executive pilot's viewpoint, have been so widely accepted in the Cleveland area that it became necessary to add another hangar eight months after operations began.

This service has since been expanded to include engine changes and 1,000-hour inspections as well as routine inspections. Local pilots no longer have to fly expensive deadhead miles to a distant airport for these services. The result is more useful air hours for airplanes.

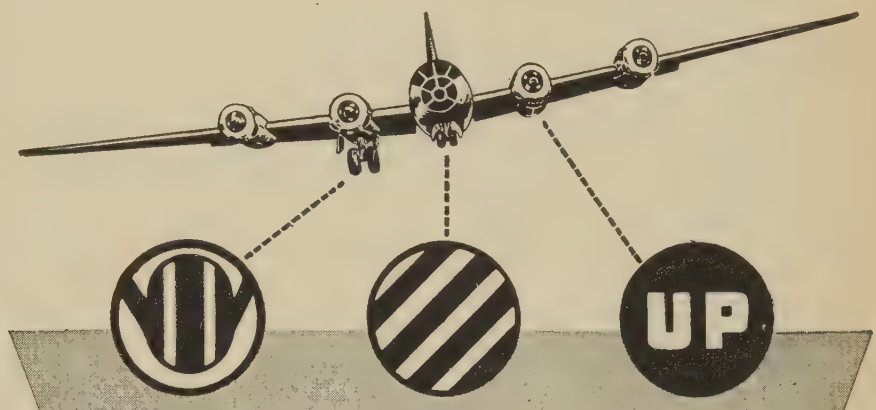
The establishment of Aircraft Service as a separate business has brought many advantages to the flight personnel. The over-all program provides collateral duties for the pilots, giving them invaluable experience in straight business operations. This experience is helpful to pilots who may one day be faced with a desk job, and it utilizes time that otherwise might be wasted.

For example, Clint Bacastow, chief pilot, is vice president of Aircraft Service, Inc. A. L. Jones, first pilot for multi-engine equipment, is sales manager. W. E. McMurray, also first pilot for multi-engine aircraft, is assistant in flight operations and K. A. Brown, first pilot for single-engine equipment, is assistant to Bacastow. The other two pilots are L. S. Dryer and D. L. Tuttle.

All pilots attached to Aircraft Service wear identical, distinctive blue uniforms while flying. The uniform is of a quality, dark blue gabardine and to be well dressed for almost any occasion on the ground a pilot simply removes his uniform coat and puts on a jacket tailor-made of the same material.

The flight record presents a good

(*Continued on page 40*)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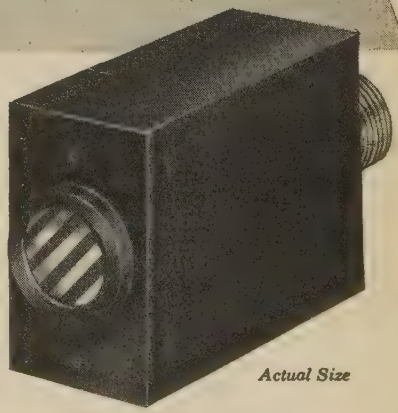

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**PERSONNEL**

**Harold C. Stuart** has been elected president of the Aircraft Service Association, an organization representing leading aircraft and engine overhaul, modification and service companies.

**J. H. Carmichael,** president of Capital Airlines, was elected to the Board of Directors of the Air Transport Association.

**John P. W. Vest** of Sikorsky Aircraft was elected President of the American Helicopter Society at its 10th Annual Forum in Washington, D. C. **Henry S. Tremper** of Piasecki was named Secretary; **Col. William B. Bunker,** U. S. Army, was elected Treasurer; **Jack Cherno,** Sikorsky, was named Vice President—New England Region; **Leon Crane,** Piasecki, Vice President— Mideast Region; **Herbert Moseley,** American Helicopter Div., Vice President—Western Region; **LCdr. J. A. H. Torry, Jr.,** U. S. Navy, Vice President—Southeast Region; **Freidrich von Doblhoff,** McDonnel Aircraft, Vice President—Midwest Region; and **Robert Lichten,** Bell Aircraft, Vice President—Southwest Region.

**R. S. Bowditch** has been named General Manager, American Gyro Corporation, Santa Monica, Calif. **R. B. Kees** was appointed Executive Vice President, and **D. J. Santogrossi,** Chief Engineer.

**H. Don Reynolds** has been retained as General Counsel and elected a vice president of Flight Safety, Inc.

**G. R. Thornton** recently was appointed assistant general sales manager for Trans World Airlines.

**John W. Larson** has joined Chance Vought Aircraft, Inc., as staff assistant to **Fred Dickerman,** CV chief engineer.

**Charles J. Adolph, Jr.** has been appointed Manager of the West Coast office of Kollsman Instrument Corporation.

**Al Blackburn** and **Al White,** both former military pilots, have joined North American as engineering test pilots.

**Rodgers Donaldson,** formerly Lockheed Aircraft's eastern manager, has rejoined the company as assistant chief counsel.

**L. Byron Post** has been named Superintendent of Production and Service for Dallas Aero Service.

**McGregor Smith** recently was elected to the Board of Directors of Eastern Air Lines.

**J. W. Baird** has been elected assistant secretary of Pacific Airmotive Corporation.

**James R. Sawyer** has been appointed Director of Material for Aerodex, Inc. **R. S. Skidmore** has been named Manager of Public Relations and Advertising.

**Kenneth Slawson** has been made Vice President of the Ford Instrument Company Division by action of the Board of Directors of The Sperry Corporation.

**James L. Murray** has joined The Garrett Corp. as engineering representative.

**R. B. Grant** has been appointed Los Angeles branch manager for Minneapolis-Honeywell Regulator Company.

**COMPANIES**

**Eclipse-Pioneer** recently was awarded the first equipment contract to be placed by the USAF under the "new weapons system concept—associate method of procurement." The contract covers the design, development and production of the PB-10 autopilot system for the YC-133 aircraft.

**Fairchild Engine and Airplane Corp.,** has announced plans to open a plant at the St. Augustine (Florida) Municipal Airport.

**Flight Refueling, Inc.,** is now in full operation at its new plant adjacent to Baltimore's Friendship International Airport.

**General Air Transport, Inc.,** has inaugurated helicopter service in and around New Orleans, La. The company is using a Bell 47G, flown by Chief Pilot Al Holmgren, and base of operations is Moisant International Airport.

**General Textile Mills, Inc.,** has appointed Air Associates, Inc., exclusive aviation distributor of its Gen Tex line of protective helmets, goggles and other specialized products.

**Lycoming Division,** Avco Manufacturing Corp., has been awarded a contract by the USAF for production of R-1300 reciprocating engines.

**Douglas Aircraft Co.,** has purchased Grand Central Aircraft Company's Tucson Division and negotiated a lease with the Tucson Airport Authority.

**AWARDS**

**Michael Gluhareff,** chief engineer of Sikorsky Aircraft, received the Dr. Alexander Klemin award at the American Helicopter Society's 10th Annual Honors Night Dinner at the Mayflower Hotel in Washington, D. C. Other awards at the dinner include Honorary Fellowships to **Ferdinand Moran,** CAB examiner, and **Floyd Carlson,** chief test pilot, Bell Aircraft's helicopter division. The U. S. Navy was the recipient of the Capt. William J. Kossler Award for "anti-submarine warfare operations during 1953."

**AERO CALENDAR**

July 27-Aug. 5—21st National Soaring Championship. Elsinore, Calif.

Aug. 9-11—Institute of Aeronautical Sciences, turbine-powered air transportation meeting. Seattle, Wash.

Aug. 22—National Air Show, Hazelton, Pa.

Aug. 25-27—Western Electronic Show and Convention sponsored by West Coast Electronics Mfg. Assn., and IRE. Ambassador Hotel, Los Angeles.

Sept. 4-6—National Aircraft Show, Dayton, Ohio.

Sept. 13-24—Instrument Society of America, International Instrument Congress and Clinic, Philadelphia.

Oct. 4-6—National Electronics Conference, Hotel Sherman, Chicago.

Oct. 5-7—Champion Spark Plug Co., Annual Aircraft Spark Plug and Ignition Conference. Secor Hotel, Toledo, Ohio.

## Reducing Costs . . .

*(Continued from page 39)*

picture of the Russell Company operations since 1948, the year the second aircraft was added. It looks like this:

| Year | Hrs. | Miles | Passgr. Miles |
|---|---|---|---|
| 1948 | 739 | 105,908 | 300,356 |
| 1949 | 1,466 | 226,507 | 539,576 |
| 1950 | 1,459 | 221,650 | 514,353 |
| 1951 | 1,694 | 254,947 | 576,325 |
| 1952 | 2,442 | 356,166 | 845,680 |
| 1953 | 2,822 | 409,506 | 1,248,957 |

The fleet now includes a Cessna 170, a Beech *Bonanza*, a Beech D-18, and a Douglas DC-3 (a Remmert-Werner conversion).

Bacastow, former Air Force instructor with more than 8,000 hours, sums the revitalized Russell Company operation up this way:

"The combined operation of a fleet of company aircraft and a completely equipped maintenance service has proved the most economical approach as well as the most efficient. Aircraft utilization has gone up and service for the Russell Company, which after all is the basic reason for our existence, has reached a new high. In addition, the same advantages have been realized by other companies who are customers of Aircraft Service for both maintenance and charter of aircraft.

"More and more companies are realizing that the company-owned airplane is not a luxury but an essential means of doing business. With the necessity of putting all phases of our business on an efficient basis to remain in a good competitive position, we in flight operations are continuously striving to find ways of improving utility and costs."

Mr. Russell, whose company won nation-wide acclaim among the small fry a few years ago by offering to pay the cost of any window pane shattered in the course of a sandlot baseball game, looks at the operation this way:

"I have been sold on the airplane for fast, dependable executive transportation since we bought our first airplane in 1946. My faith in the airplane as an essential tool in business and industry has grown stronger each year. We have continued to need more and more air service and it makes me happy that, through the purchase of Aircraft Service, we have been able to obtain that service economically and to extend economical transportation to other companies. It looks as though we are in the aviation business to stay."

## Design for Safety

(*Continued from page 11*)

much better to provide simple, direct, ruggedized systems backed up when necessary by independent and simple emergency actuating systems rather than complicating the original system design by double or triple protective devices until the basic system is so entwined with the emergency system that the probability of mechanical failure is multiplied, not to mention the possibilities of human failure to cope with involved sequential gyrations or complex procedures. So-called human failure of this type is frequently the result of failure of the designer to recognize human limitations to cope rapidly with complicated interrelated functions, particularly when erroneous and sometimes incomplete information is available. Design it simple. Make it simple to operate. Make it so it cannot be incorrectly sequenced or operated. Make it so it cannot be incorrectly installed, but always strive to retain the ultimate in simplicity. By "simple" design I mean design which is uncompounded, uncombined, elementary, free from unnecessary complexity, not hard to understand, straight forward and plain. With ever-increasing system-performance demands, this is not easy but will, if and to the degree attained, surely result in still safer aircraft than are operated today.

The fourth item or recommendation through which safety can be still further improved in the future is *to learn more about ourselves, i.e.*, the human machine and its limitations, through research, and to consider this human-engineering knowledge the definite design parameters. While some work has been done, the complex relationship of the human to the design problem should be investigated much more thoroughly. For example, we should try to determine human behavior when stimulated by sets of adverse circumstances to determine the action that can reasonably be expected when mechanical failures occur under certain critical conditions. It is time we pursued human research with the same zeal that is typical of such items as structural or powerplant research. The flight simulator arranged to represent designs of systems under study would seem to be a very good vehicle by which design philosophies could be explored and evaluated in terms of human response and limitations under both normal and emergency conditions. This is but one of a number of practical avenues of

(*Continued on page 42*)


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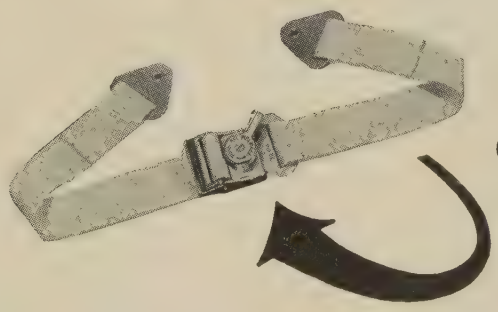

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For instance in a recent airline accident official reports stated with certainty that many of the passengers could have been saved had they been able to release their seat belts instantly.

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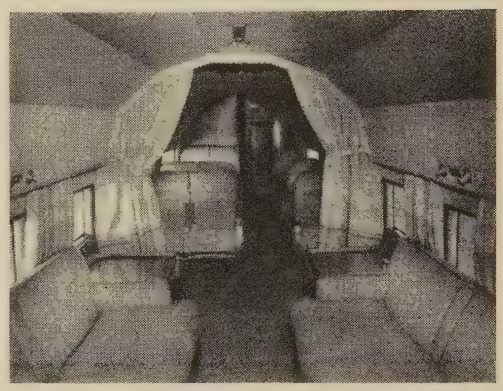

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## Design for Safety

(*Continued from page 41*)

approach open to gaining more information; however, the real point I wish to make here is that ultimate absolute safety can be developed best if designers can more reliably tailor their designs to the human and his natural limitations.

The next point I would like to make is that *use of mock-ups and prototype design testing are helpful during the development stage.*

Airlines have encountered and have had to overcome unsatisfactory conditions which, with but a modest amount of additional testing under conditions more representative of actual operations, could have been avoided. I am sure most of us can agree that it is usually cheaper and more prudent to correct design deficiencies prior to and not after placing the article into production. Not long ago a manufacturer of a relatively new transport corrected an inadequate air-flow problem in the airplane's heating system by adding a second ventilating blower downstream of the heater. (*Fig. 1*). The combustion air supply into the heater was taken from a point in the ventilating air duct upstream of the heater. This worked well until certain exigencies arose in which the upstream ventilating blower failed and the added blower continued to run. This caused a suction at the combustion air take-off which pulled smoke into the ventilating airstream. Had this system originally been more adequately mocked up, the basic inadequate airflow condition which led to the installation of the second blower would have been discovered and corrected. Further, solution to the problem would not have been limited by the existence of the finished article which required a rapid operational change, but would have been solved pretty much as was finally done anyway. The final arrangement, accomplished when the airplane was in service, incorporated a completely independent combustion air system and eliminated the additional blower by cleaning up the original duct system, decreasing the pressure loss which had originally required the additional blower. Many design deficiencies can be engineered out during development by use of detail mock-ups suitable for not only determining system performance but safety aspects as well by rational simulation of component failures.

In a case in point, a blower was overheating, failing after only a few hours of operation, the final stages of failure being accompanied by large quantities of smoke. Investigation revealed that the cooling fan in the motor was opposing the air flow required for cooling. The result was that the motor simply was not being adequately cooled and, of course, failed. The cooling fan was reversed and the problem thus solved. (*Fig. 2*).

This difficulty could easily have been determined with more complete working mock-ups during the development stages. Needless to say, the existence of smoke, even though the cause may not mechanically impair flight safety, can lead to worried action which, like false warnings, is not necessarily in the best interest of safety.

Other examples could be cited, but the two given should serve to illustrate the point that while mock-ups have been used extensively in the past, safety can be better insured through still more extended use of them in the future. One of the leading English manufacturers developed a complete working mock-up to aid in the development of a very large four-engine, turboprop-powered transport. This is a metal mock-up and is virtually a complete airplane, except for outboard wing panels and portions of the tail surfaces. It includes airplane structure, airplane systems, powerplant, landing gear, etc. This company made use of the mock-up for design and system performance verification. Considerable engineering time was saved by using the mock-up to check out hydraulic plumbing runs, separation of hydraulic tubing from electrical wiring, integration and separation of system components, maintenance accessibility, system performance and unit reliability. The mock-up was retained following prototype development and is now used as an aid in making changes and improvements in design necessitated by the availability of new products, further service experience with the aircraft, etc. Through use of this mock-up many not-so-obvious faults were discovered and resulting design improvements were incorporated in the prototype airplane.

The advantages to this method of expediting design are so obvious that it is rather surprising a wider use of the complete metal mock-ups has not been made. Also, much can

(*Continued on page 46*)

## Cost Estimates

(*Continued from page 16*)

| | | | |
|---|---|---|---|
| *Engine Magneto* | 0.3 | 0.7 | 1.0 |
| *Engine Ignition Manifold* | 1.5 | 2.0 | 3.5 |
| *Engine-Driven Generator* | 0.3 | 0.7 | 1.0 |
| *Induction Vibrator* | 0.4 | 0.6 | 1.0 |
| *Engine Spark Plugs* | 1.0 | 1.5 | 2.5 |
| *Tachometer Generator* | 0.2 | 0.3 | 0.5 |
| *Engine Starter Assembly* | 0.3 | 0.7 | 1.0 |
| *Thermocouple Washer* | 0.1 | 0.2 | 0.3 |
| *Anti-Drag Ring Cowl* | 0.2 | 0.5 | 0.7 |
| *Accessory Cowl* | 0.2 | 0.5 | 0.7 |
| *Engine Exhaust Manifold* | 3.0 | 5.0 | 8.0 |
| *Propeller Governor* | 0.3 | 0.7 | 1.0 |
| *Engine-Driven Fuel Pump* | 0.2 | 0.3 | 0.5 |
| *Autopilot Hydraulic Pump* | 0.2 | 0.3 | 0.5 |
| *Hydraulic System Pump* | 0.2 | 0.3 | 0.5 |
| *Engine-Driven Vacuum Pump* | 0.2 | 0.3 | 0.5 |
| *Oil Separator* | 0.3 | 0.4 | 0.7 |
| *Fuel Primer Solenoid* | 0.1 | 0.2 | 0.3 |
| *Engine Supercharger Drain Valve* | 0.2 | 0.3 | 0.5 |
| *Engine Oil Dilution Solenoid* | 0.1 | 0.2 | 0.3 |
| *Engine Ignition Switch* | 0.4 | 0.6 | 1.0 |
| | 11.5 | 19.3 | 30.8 |
| Engine Oil System Forward of Firewall | | | |
| *Engine Oil Cooler* | 0.8 | 1.4 | 2.2 |
| *Oil Temperature Regulator* | 0.6 | 1.2 | 1.8 |
| *Engine Oil Cooler Air Scoop* | 0.3 | 0.5 | 0.8 |
| | 1.7 | 3.1 | 4.8 |
| Engine Oil System Aft of Firewall | | | |
| *Engine Oil Tank* | 1.0 | 1.5 | 2.5 |
| *Firewall Shut-Off Valve* | 0.7 | 1.3 | 2.0 |
| *Fuselage Aux. Oil Tank* | 1.0 | 2.6 | 3.6 |
| *Fuselage Oil Tank Select. Valve* | 0.3 | 0.7 | 1.0 |
| *Fuselage Oil Transfer Pump* | 1.0 | 2.0 | 3.0 |
| | 4.0 | 8.1 | 12.1 |
| Fuel System Aft of Firewall | | | |
| *Fuel Tank Selector Valve* | 0.8 | 1.0 | 1.8 |
| *Fuel Cross-Feed Valve* | 1.0 | 1.2 | 2.2 |
| *Fuel Drain Valve* | 0.2 | 0.5 | 0.7 |
| *Firewall Shut-Off Valve* | 0.7 | 1.3 | 2.0 |
| | 2.7 | 4.0 | 6.7 |
| Flight Instruments | | | |
| *Altimeter* | 0.3 | 0.4 | 0.7 |
| *Magnetic Compass* | 0.2 | 0.3 | 0.5 |
| *Clock* | 0.2 | 0.3 | 0.5 |
| *Airspeed Indicator* | 0.2 | 0.3 | 0.5 |
| *Turn-and-Bank* | 0.2 | 0.3 | 0.5 |
| *Rate-of-Climb* | 0.2 | 0.3 | 0.5 |
| *Remote Compass Indicator* | 0.3 | 0.5 | 0.8 |
| *Remote Compass Transmitter* | 0.3 | 0.5 | 0.8 |
| *Directional Gyro Indicator* | 0.4 | 0.6 | 1.0 |
| *Artificial Horizon* | 0.4 | 0.6 | 1.0 |
| *Autopilot Relay* | 0.5 | 0.7 | 1.2 |
| | 3.2 | 4.8 | 8.0 |
| Aircraft & Engine Instruments | | | |
| *De-Icer Air Pressure Gauge* | 0.2 | 0.3 | 0.5 |
| *Hydraulic Gauge* | 0.6 | 0.7 | 1.3 |
| *Autopilot Oil Pressure Gauge* | 0.3 | 0.4 | 0.7 |
| *Oxygen Pressure Gauge* | 0.2 | 0.3 | 0.5 |
| *Fuel Pressure Gauge* | 0.2 | 0.3 | 0.5 |
| *Manifold Pressure Gauge* | 0.2 | 0.3 | 0.5 |
| *Vacuum Pressure Gauge* | 0.2 | 0.3 | 0.5 |
| *Oil Pressure Gauge* | 0.2 | 0.3 | 0.5 |
| *Air Brake Pressure Gauge* | 0.2 | 0.3 | 0.5 |
| *Outside Air Temp. Gauge* | 0.3 | 0.4 | 0.7 |
| *Oil Temperature Indicator* | 0.3 | 0.4 | 0.7 |

(*Continued on page 44*)

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**ACCURACY**—TEMPCAL Tester temperature readings are made on a highly accurate potentiometer; guaranteed accuracy is ±5°F with temperatures ranging from 0° to 800°F. Heater probes used for cylinder head thermocouples are guaranteed accurate to ±4°C at 0° to 300°C operating temperatures.

**FASTER MAINTENANCE CHECKS**—It is no longer necessary to take thermal switches to the "lab" for testing. TEMPCAL probes reach a temperature of 800°F in about 8 minutes for quick maintenance checks *on the aircraft.*

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**B & H INSTRUMENT**
Company, Inc.
1009 Norwood
FORT WORTH 7, TEXAS


## Cost Estimates

(*Continued from page 43*)

| | | | |
|---|---|---|---|
| *Carburetion Air Temp. Indicator* | 0.3 | 0.4 | 0.7 |
| *Cylinder Head Temp. Indicator* | 0.3 | 0.4 | 0.7 |
| *Oil Quantity Indicator* | 0.3 | 0.4 | 0.7 |
| *Fuel Quantity Indicator* | 0.3 | 0.4 | 0.7 |
| *Tachometer* | 0.2 | 0.3 | 0.5 |
| *Fuel Flow Indicator* | 0.3 | 0.4 | 0.7 |
| *Anti-Icing Fluid Indicator* | 0.3 | 0.4 | 0.7 |
| *Wing Flap Position Indicator* | 0.3 | 0.4 | 0.7 |
| *Fuel Flow Pressure Transmitter* | 0.4 | 0.6 | 1.0 |
| *Fuel Pressure Transmitter* | 0.3 | 0.4 | 0.7 |
| *Oil Pressure Transmitter* | 0.3 | 0.4 | 0.7 |
| *Oil Quantity Transmitter* | 0.5 | 0.6 | 1.1 |
| *Fuel Quantity Transmitter* | 0.8 | 1.2 | 2.0 |
| *Anti-Icing Fluid Transmitter* | 0.7 | 0.8 | 1.5 |
| *Wing Flap Position Transmitter* | 0.8 | 1.2 | 2.0 |
| *Fuel Pressure Warning Unit* | 0.4 | 0.5 | 0.9 |
| *Oil Pressure Warning Unit* | 0.4 | 0.5 | 0.9 |
| *Oil Temperature Bulb* | 0.2 | 0.3 | 0.5 |
| *Carburetor Air Temp. Bulb* | 0.2 | 0.3 | 0.5 |
| *Voltmeter* | 0.2 | 0.3 | 0.5 |
| *Ammeter* | 0.3 | 0.4 | 0.7 |
| *Pitot Ammeter* | 0.3 | 0.4 | 0.7 |
| *Vacuum Relief Valve* | 0.3 | 0.4 | 0.7 |
| *Vacuum Pump Selector Valve* | 0.5 | 0.5 | 1.0 |
| *Oxygen Pressure Regulator* | 0.2 | 0.3 | 0.5 |
| *Vacuum Static Manifold Select* | 0.8 | 0.9 | 1.7 |
| | 12.8 | 17.1 | 29.9 |
| Nose Landing Gear | | | |
| *Complete Nose Gear Assembly* | 4.0 | 12.0 | 16.0 |
| *Ahrens Control Assembly* | 0.5 | 1.5 | 2.0 |
| *Wheel and Axle Assembly* | 0.3 | 0.5 | 0.8 |
| *Steering Follow-Up Mechanism* | 1.5 | 4.5 | 6 0 |
| *Doors & Actuating Mechanism* | 1.0 | 2.0 | 3.5 |
| *Up-Latch Assembly* | 0.5 | 0.8 | 1 3 |
| | 7.8 | 21.3 | 29.1 |
| Main Gear Assembly (One Side) | | | |
| *Complete Main Gear Assembly* | 8.0 | 20.0 | 28.0 |
| *Brake & Wheel Assembly* | 2.0 | 6.0 | 8.0 |
| *Landing Gear Actuating Mechanism* | 3.0 | 7.0 | 10.0 |
| *Up-Latch Assembly* | 1.0 | 2.5 | 3.5 |
| *Drag Link Assembly* | 0.5 | 1.0 | 1.5 |
| *Bungee Assembly* | 1.0 | 2.0 | 3.0 |
| | 25.5 | 38.5 | 54.0 |
| Hydraulic System Components | | | |
| *Nose Wheel Steering Shut-Off* | 0.3 | 0.7 | 1.0 |
| *Nose Wheel Str Orifice Check* | 0.2 | 0.3 | 0.5 |
| *Nose Wheel Str Relief Valve* | 0.3 | 0.4 | 0.7 |
| *Nose Wheel Str Selector Valve* | 1.0 | 2.0 | 3.0 |
| *Nose Wheel Str Relief Shut-Off* | 0.3 | 0.7 | 1.0 |
| *Brake Control Valve* | 1.0 | 2.0 | 3.0 |
| *Autopilot Pressure Shut-Off Valve* | 1.0 | 1.5 | 2.5 |
| *Windshield Wiper Needle Valve* | 1.0 | 1.5 | 2.5 |
| *Cowl Flap Constant Flow Valve* | 0.3 | 0.5 | 0.8 |
| *Cowl Flap Selector Valve* | 0.7 | 2.3 | 3.0 |
| *Cowl Flap Temp Relief Valve* | 0.5 | 0.8 | 1.3 |
| *Windshield Wiper Press. Reducer* | 1.0 | 1.5 | 2.5 |
| *Brake Balance Relief Valve* | 1.0 | 1.5 | 2.5 |
| *Dash Pot Check Valve* | 0.3 | 0.5 | 1.0 |
| *Landing Gear Selector Valve* | 0.5 | 1.0 | 1.5 |
| *L.G. Emergency Ext. Valve* | 0.5 | 1.0 | 2.5 |
| *L.G. Temp Relief Valve* | 0.5 | 0.5 | 1.0 |
| *Hydraulic Press Regulator Valve* | 0.7 | 1.0 | 1.7 |
| *Hydraulic System Relief Valve* | 0.6 | 0.8 | 1.2 |
| *8 Psi Air Vent Relief Check Valve* | 0.2 | 0.3 | 0.5 |
| *20 Psi Relief Check Valve* | 0.2 | 0.3 | 0.5 |
| *Landing Gear Vent Check Valve* | 0.1 | 0.2 | 0.3 |
| *Hydraulic Return Check Valve* | 0.1 | 0.2 | 0.3 |

| | | | |
|---|---|---|---|
| *Autopilot Drain Check* | 0.1 | 0.2 | 0.3 |
| *Hand Pump Supply Reservoir Check* | 0.1 | 0.2 | 0.3 |
| *Autopilot Drain Venturi* | 0.2 | 0.3 | 0.5 |
| *Autopilot Press Reg. Valve* | 0.5 | 0.7 | 1.2 |
| *Wing Flap Check Valve* | 0.2 | 0.4 | 0.6 |
| *Wing Flap Press-Opera Check Valve* | 0.2 | 0.4 | 0.6 |
| *Wing Flap Temp Relief Valve* | 0.3 | 0.4 | 0.7 |
| *Wing Flap Position Select Valve* | 0.4 | 0.6 | 1.0 |
| | 14.3 | 24.7 | 39.0 |
| Hydraulic System Miscellaneous Components | | | |
| *Nose Wheel Steering Cylinder* | 1.9 | 2.1 | 4.0 |
| *Nose Wheel Bungee Cylinder* | 0.5 | 0.5 | 1.0 |
| *Nose Wheel Retraction Cylinder* | 1.0 | 2.0 | 3.0 |
| *Main Gear Retraction Cylinder* | 2.0 | 2.1 | 4.1 |
| *Wing Flap Actuating Cylinder* | 0.8 | 1.2 | 2.0 |
| *Cowl Flap Actuating Cylinder* | 0.5 | 0.6 | 1.1 |
| *Hydraulic Fluid Reservoir* | 0.5 | 1.5 | 2.5 |
| *H.F. Reservoir Filter* | 0.6 | 1.0 | 1.6 |
| *Hydraulic System Press Accumulator* | 0.8 | 1.0 | 1.8 |
| *Nose Gear Pressure Accumulator* | 0.3 | 0.8 | 1.1 |
| *Brake Pressure Accumulator* | 0.3 | 0.8 | 1.1 |
| *Windshield Wiper Motor Assembly* | 0.7 | 1.3 | 2.0 |
| *Hydraulic Fluid Hand Pump* | 0.8 | 1.2 | 2.0 |
| *Cowl Flap Actuating Cyl. Assembly* | 0.7 | 1.8 | 2.5 |
| *Autopilot Servo Unit* | 0.8 | 1.2 | 2.0 |
| *Autopilot Balanced Oil Valve* | 0.7 | 1.0 | 1.7 |
| *Connector Assembly Test Stand* | 0.2 | 0.3 | 0.5 |
| *Air Brake Control Valve* | 0.5 | 0.8 | 1.3 |
| *Air Brake Shuttle Valve* | 0.3 | 0.5 | 0.8 |
| *Fire Wall Shut-Off Valve* | 0.7 | 1.3 | 1.0 |
| *Hydraulic Control Power System (Manifold Assembly)* | 0.8 | 2.0 | 2.8 |
| *Brake De-Booster* | 0.2 | 0.2 | 0.4 |
| | 15.6 | 25.2 | 40.8 |
| Wing Structure | | | |
| *Outer Wing Assembly* | 16.0 | 24.0 | 40.0 |
| *Inspection Access Plates (Fuel Tks)* | 24.0 | 32.0 | 56.0 |
| | 40.0 | 56.0 | 96.0 |
| Fuselage Structure | | | |
| *Wing Fuselage Fillet* | 2.0 | 4.0 | 6.0 |
| Empennage | | | |
| *Verticle Stabilizer Assembly* | 7.0 | 8.0 | 15.0 |
| *Horizontal Stabilizer Assembly* | 4.0 | 5.0 | 9.0 |
| *Tail Cone* | 1.5 | 2.0 | 3.5 |
| *Tail Skid Fairing Assembly* | 0.3 | 0.5 | 0.8 |
| | 12.8 | 15.5 | 28.3 |
| Center Wing Structure | | | |
| *Wing Flap* | 4.0 | 8.0 | 12.0 |
| *Wing Flap Door Drive Mechanism* | 0.8 | 1.0 | 1.8 |
| | 4.8 | 9.0 | 13.8 |
| Control System | | | |
| *Rudder & Trim Tab* | 4.0 | 6.0 | 10.0 |
| *L.H. Aileron (R.H. similar)* | 0.8 | 4.0 | 4.8 |
| *L.H. Elevator & Trim Tab (R.H.)* | 1.0 | 4.0 | 5.0 |
| *Aileron Trim Tab* | 0.3 | 0.5 | 0.8 |
| *L.H. Elevator Trim Tab* | 0.3 | 0.5 | 0.8 |
| *R.H. Elevator Trim Tab* | 0.3 | 0.5 | 0.8 |
| *Rudder Flying Trim Tab Mech* | 1.0 | 3.0 | 4.0 |
| *Aileron Trim Tab Mech* | 1.0 | 2.0 | 3.0 |
| *R.H. Elevator Tab Mechanism* | 1.8 | 3.5 | 4.3 |
| *L.H. Elevator Tab Mechanism* | 1.8 | 2.5 | 4.3 |
| | 12.3 | 26.5 | 38.8 |
| Aircraft Accessories | | | |
| *De-Icer System Control Valve* | 0.7 | 1.1 | 0.8 |
| *Distributor Valve & Motor* | 0.5 | 1.5 | 2.0 |
| *Main Oil Separator* | 0.5 | 1.0 | 1.5 |
| *Empennage De-Icer Boots* | 10.0 | 60.0 | 70.0 |
| *Wing De-Icer Boots* | 24.0 | 200.0 | 224.0 |
| *Anti-Icer System Fluid Tank* | 1.0 | 1.5 | 2.5 |
| *Anti-Icer System Pump* | 0.5 | 1.0 | 1.5 |

*(Continued on page 46)*


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8-54

## Cost Estimates

(*Continued from page 45*)

| | | | |
|---|---|---|---|
| *Anti-Icer Solenoid Valve* | 0.2 | 0.3 | 0.5 |
| *$CO_2$ Selector Valve* | 0.5 | 0.7 | 1.2 |
| *$CO_2$ Cylinder* | 0.5 | 0.7 | 1.2 |
| *Weighing of $CO_2$ Cylinder* | .. | .. | 0.2 |
| *Fire Warning Switches* | 0.2 | 0.3 | 0.5 |
| *Replace Heater Filter Element* | 0.2 | 0.3 | 0.5 |
| *Heater Assembly* | 1.0 | 2.0 | 3.0 |
| *Heater Ignition Vibrator* | 0.2 | 0.3 | 0.5 |
| *Heater Solenoid Valve* | 0.2 | 0.3 | 0.5 |
| *Heater Fuel Pump* | 0.2 | 0.3 | 0.5 |
| *Heater Fuel Pressure Regulator* | 0.3 | 0.5 | 0.8 |
| *Nose Heater Blower* | 0.5 | 1.0 | 1.5 |
| *Oxygen Tank* | 0.3 | 0.7 | 1.0 |
| *Oxygen Pressure Gauge* | 0.3 | 0.4 | 0.7 |
| *Oxygen Pressure Regulator* | 0.2 | 1.0 | 1.2 |
| *Emergency Flare* | 0.2 | 0.4 | 0.6 |
| | 42.2 | 275.3 | 317.7 |
| Aircraft Electrical Accessories | | | |
| *Starter Solenoid Switch* | 0.5 | 0.5 | 1.0 |
| *Propeller Feathering Solenoid* | 0.3 | 0.5 | 0.8 |
| *Fuel Booster Pumps* | 1.0 | 1.3 | 2.3 |
| *Landing Gear Safety Solenoid* | 0.4 | 0.6 | 1.0 |
| *Ground Power Relay* | 0.4 | 0.7 | 1.1 |
| *Battery Relay* | 0.4 | 0.7 | 1.1 |
| *Voltage Regulator* | 0.2 | 0.4 | 0.6 |
| *Prop Governor Press Cut-Off Sw.* | 0.2 | 0.4 | 0.6 |
| *Navigation Flasher* | 0.2 | 0.4 | 0.6 |
| *Landing Light Relay* | 0.3 | 0.5 | 0.8 |
| *Electrical Inverter* | 0.7 | 1.0 | 1.7 |
| *Landing Gear Warning Switch* | 0.3 | 0.5 | 0.8 |
| *Throttle Warning Switch* | 1.4 | 1.6 | 3.0 |
| *Warning Horn* | 0.2 | 0.4 | 0.6 |
| *Battery* | 0.3 | 0.5 | 0.8 |
| *Reverse Current Control Relay* | 0.2 | 0.3 | 0.5 |
| *Landing Light & Motor* | 0.3 | 0.5 | 0.8 |
| *Prop Feathering Pump* | 0.3 | 0.5 | 0.8 |
| | 7.6 | 11.3 | 18.9 |
| *Sum Total Man-Hours* | | | 775.8 |

**Preparation of Overhaul:** It is somewhat difficult to estimate the amount of man-hours that will actually be expended in the over-haul of components. This depends upon experience of the mechanical personnel assigned to this work, availability of replacement parts, etc. However, some empirical figures (C-54) are submitted.

| Apportionment Of Work | Man-Hours In Labor |
|---|---|
| *Fuel Tank Charting*<br>*Inspection Access Plate Removal*<br>*Fuel Tank Stripping*<br>*Structural Repairs*<br>*Inspection Access Plate Re-Installation*<br>*Pre-Hangar Preparation*<br>*Disassembly*<br>*Preliminary Inspection*<br>*Cleaning*<br>*Washing* | 2800<br>1100 |
| *Indirect Labor* | 480 |
| *Flight-Line Work*<br>*Flight Test* | 240 |
| *Inspection*<br>*Operational Checks* | 360 |
| *Overhaul of Airframe and Accessory Components* | 1840 |
| *Sheet Metal Work*<br>*Modifications*<br>*Painting*<br>*Rigging*<br>*Reinstallation*<br>*Engine and Propeller Work* | 1650 |
| | 8470 |

**Summary:** In order to obtain competitive prices in air-transport overhaul work, a backlog of experience and man-hour costs is helpful. However, before submitting bids for the work, an estimate using these man-hour breakdowns for the removal, installation, and preliminary work will be helpful to check prices submitted by the competitors in sealed bid proposals. As a fair assumption for the amount of direct labor man-hours, approximately 17% to 20% should be apportioned of the total amount of man-hours estimated to complete the work of overhaul.

## Design for Safety

(*Continued from page 42*)

be said in favor of use of extensive mock-ups for improving and substantiating emergency-system design as well as determining compatibility of each system with the other. Controlled tests of powerplant installation fires employing the fire extinguishing system definitely would answer many questions better than regulations and printed material.

The next point I wish to make is that *safety requires that the greatest degree of system segregation should be provided in designs.*

All fluid, plumbing and accessories should be completely isolated from ignition sources and should be sufficiently far away from electrical wiring to preclude the possibility of shorted wires burning through the plumbing lines or from fluid leaking, dripping or flowing onto electrical devices. Reasonable system and component segregation should be made one of the manufacturer's primary design criteria at the outset. The Douglas DC-2 and DC-3 were provided with plumbing tunnels forward of the wing and along the fuselage, available from the exterior of the airplane. These tunnels contained most of the plumbing runs in these parts of the airplane and isolated them from the rest of the airplane. Some of the DC-3's recently retired are believed still to have some of the original plumbing in these tunnels. This feature provided complete segregation, ease of maintenance and protection from attrition from maintenance personnel. Fuselage pressurization complicates designs of this type; however, there are many obvious and important advantages to complete segregation. Any thinking that system segregation is not important, if non-inflammable hydraulic fluids are carried, should be discouraged because non-inflammability is entirely a matter of definition and degree. At the same time we should not discourage but should definitely encourage the development of still more practical "non-inflammable" hydraulic fluids for use in new aircraft and which also would be suitable for use in currently operated aircraft. The main principle we should hope to achieve with system and component segregation is isolation of or reduction in the probability of compounding any hazards which may arise. It is important that mechanical failures, drive shafts, for example, do not tear out plumbing or wires or accessories if they fail. It is important that if a fluid line should fail, the

(*Continued on page 50*)

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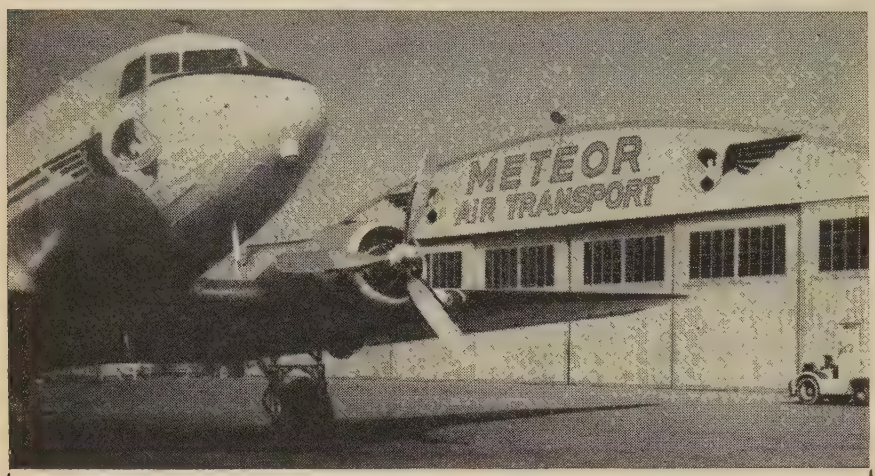


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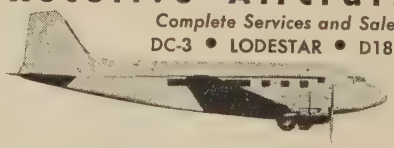

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## C-47 B

**Total airframe time: 14810 hours**
**Airframe time since overhaul: 5800 hours**
**Engines: P & W R-1830-92**
**Engine time since overhaul: Left 617 hours**
**Right 848 hours**
**Propellers: Hamilton Standard Hydromatic Paddle Blades**
**Radio:** Dual A D F—I L S—V H F—Command transmitter and Receiver—Western Electric marker beacon receiver—Glide path receiver.
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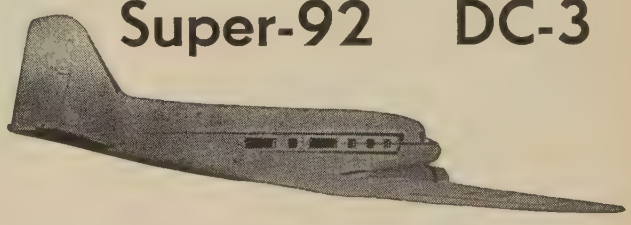

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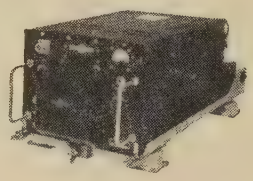

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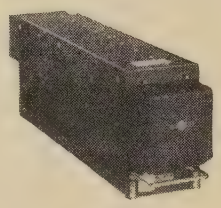

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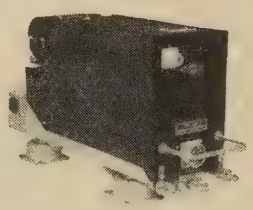

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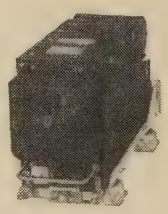

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## Design for Safety

(*Continued from page 46*)

fluid would not be discharged into an area where ignition could occur. It is important that smoke hazards, particularly in pressurized aircraft, be held to an absolute minimum by special consideration of materials used. It is important that every reasonable attention be given to isolation of any hazard which could reasonably arise.

In some locations in the airplane, complete system segregation is difficult, such as in the powerplant installation which must be a mixture of electrical and mechanical, hydraulic, fuel and oil systems. In these cases it is important to see that area segregation is complete and that the segregation will be maintained as long as possible under emergency conditions. Flexible or extensible seals should be provided so that cowling can be deformed and still maintain the needed seals. Fuel systems should always be segregated so mechanical damage in one locality will not incapacitate another engine. Major fuel system appliances, such as strainers, should be suitably located or protected. Shut-off valves at the fuel tanks should be provided in addition to firewall shut-off valves, and should be capable of positive actuation by the crew—one tank at a time or in combination. Sufficient component isolation so as to minimize the effect of progressive failure is necessary. For example, use of engine oil to drive cabin superchargers can result in contamination of the engines from supercharger failure or vice versa. Complete system segregation may, of course, never be achieved. However, past experience clearly shows the desirability of very great system segregation.

For the next item I would like to make a plea for *maintaining reasonable structural conservatism in future designs.*

Use of fatigable materials is a

(*Continued on page 52*)

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(*Continued from Page 51*)

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## Design for Safety

(*Continued from page 50*)

trend which we should question. Unless the application of such materials is well studied and unless the detail design of parts takes into account greater inherent susceptibility to fatigue, we do ourselves a disservice. Such materials should be used conservatively and only in locations not subject to shock or tension loads. I would hate to see load factors and margins of strength reduced in future designs compared to what we have experienced in the past just because experience indicates that the basis used in the past has been good. Indeed, one might be inclined to think that load factors should be raised in the future because of the increasing importance of dynamic loads as speed increases. Perhaps it is not necessary to point out that as yet there has been no high utilization service with new type high-speed, turbine-powered commercial aircraft. Such aircraft will have certain structural advantages and perhaps disadvantages compared to present aircraft. For example, I doubt if we yet know the affect, if any, of the high-frequency, low-amplitude vibration on the airframe nor are we fully familiar with local accelerations and structural loading due to dynamic responses when flying at high speed even in mild turbulence, nor should we lose sight of the latest data which indicate that while the frequency is less, gust intensity is not necessarily less at high altitudes than at low altitudes. While the probability of encountering high-intensity gusts at high altitudes is less than at lower altitudes, this does not necessarily insure maintaining reasonable structural margins unless those margins are proportionately compatible with loads involved when encountering gusts, however infrequent, at higher speeds and altitudes. This whole point can be summed up as a plea for structural conservatism and for use of ductile materials.

*Crashworthiness vs. airworthiness* is certainly a big subject. I think most will agree that the first job of any designer or manufacturer in building for greatest safety is to provide the greatest practical degree of airworthiness for the crew and passengers. It is far more important to build an airplane so that it will not encounter trouble than it is to make it so it meets trouble well. On the other hand there are many features of design which can provide, in the over-all interests of safety, reasonable crashworthiness without sacrifice of airworthiness features. These should be provided to the maximum extent possible. Such things as elimination of sharp objects with which the body can come in contact, elimination of the possibility of doors or panels becoming missiles in the event of sudden depressurization, adequate retention of accessories such as fire extinguishers, first aid kits and the like so they cannot be torn loose, special attention to detail design features of seats, such as softening the impact of the seat backs, the providing of deformable seat armrests and the like are important considerations. Current research in the crashworthiness field is most commendable and should continue. However, we should never lose sight of the primary objective of good commercial aircraft design, which is to make the airplane safe and reliable so that minimum cause for trouble will develop.

Emergency evacuation is closely related to crashworthiness. Considerable progress has been made in this field and should be continued. For example, passenger evacuation chutes which do not require support by hand at the ground would help. Location and size of emergency exits or doors is certainly a suitable subject for constant attention. The same is true of means for getting from a window-type exit to the ground. Additional tests and research on this subject should continue.

In conclusion, I would like to make one more point on safety and that is the extreme importance of keeping the draftsmen, the detailers and the designers fully informed with respect to service experience. While airplane manufacturers universally attempt to accomplish this, I would like to recall to you that many of our difficulties are due to details as contrasted with major structural or component difficulties.

I would like to say again that the excellent safety record obtained by the U. S. air carriers through industry efforts at large, including the manufacturers and federal officials as well as airline personnel, is a record which we must proudly protect at all times and constantly strive to improve in the future. This can best be done by constant review of past operating experiences coupled with continuing and expanding research activities.

*"Airplane Design and Safety" is an adaptation of a paper entitled "Airplane Design in Relation to Safety" presented at the Twenty-Second Annual Meeting of the Institute of the Aeronautical Sciences, in New York City, by Mr. R. W. Rummel.*

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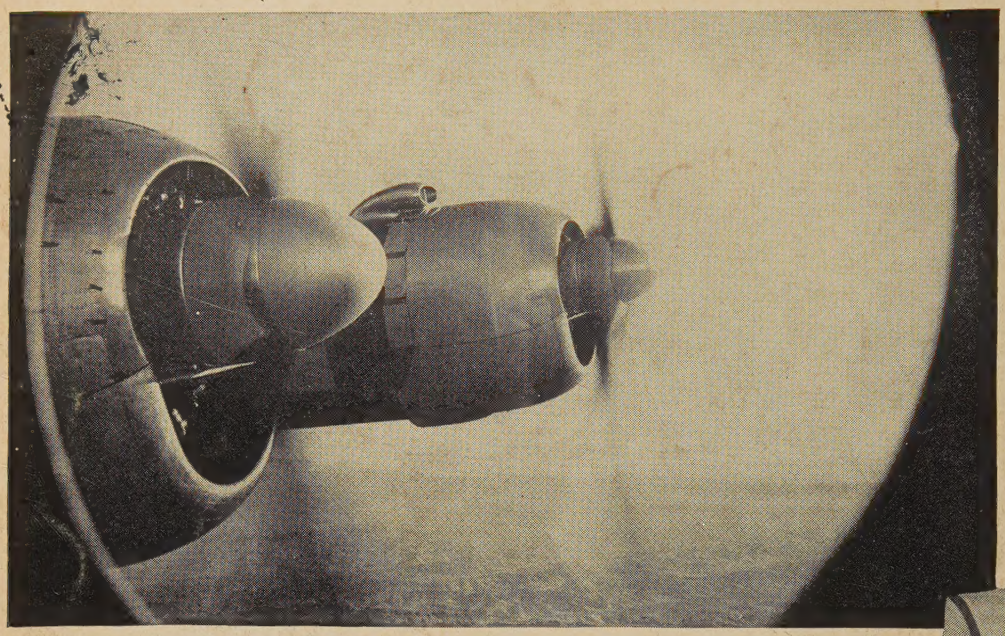
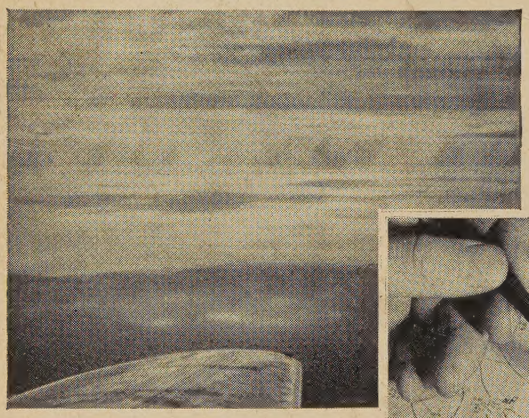
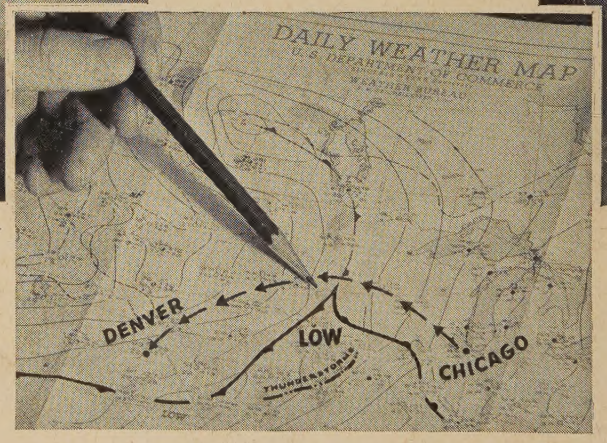


*These weather items prepared in consultation with the United States Weather Bureau*

**Rain drops** from heavy cumulus clouds which fall from colder altitudes may cool cylinder heads enough to cause engine to misfire. Avoid heavier showers wherever possible.



**Unlike showers,** rain falling from stratified cloud layers may be warmer than the air through which it falls. Be prepared for poor visibilities in the cold air near the ground, as fog is likely.




**To avoid** turbulence along squall lines, plan your trip through the northern quarter of an active low. Although instrument conditions and ice in the winter may be encountered, the severest weather will be avoided.

**Even though** stations report good weather—conditions in between are occasionally poorer. You may be unable to maintain visual contact. Check all available information on en route weather as well as your terminal weather.

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